STATISTICAL METHODS

WITH SPECIAL REFERENCE TO

BIOLOGICAL VARIATION.

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PREFACE.

THIS book has been issued in answer to a repeated call for a simple presentation of the newer statistical methods in their application to biology. The immediate need which has called it forth is that of a handbook containing the working formulæ for use at summer laboratories where material for variation-study abounds. In order that the book should not be too bulky the text has been condensed as much as is consistent with clearness.

This book was already in rough draft when the work of Duncker appeared in Roux's Archiv. I have made much use of Duncker's paper, especially in Chapter IV. I am indebted to Dr. Frederick H. Safford, Assistant Professor of Mathematics at the University of Cincinnati and formerly Instructor at Harvard University, for kindly reading the proofs and for valuable advice. To Messrs. Keuffel and Esser, of New York, I am indebted for the use of the electrotypes of Figures 1 and 2. Finally, I cannot fail to acknowledge the cordial coöperation which the publishers have given in making the book serviceable.

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June 29, 1899.

PREFACE TO THE SECOND EDITION.

THE first edition of this book having been favorably received, the publishers have authorized a revised edition embodying many of the new statistical methods elaborated chiefly by Professor Karl Pearson and his students and associates, and presenting a summary of the results gained by these methods. These, while increasing somewhat the bulk of the book, have, it is hoped, rendered it more serviceable to investigators. Too much emphasis can hardly be laid on the debt that Biometricians owe to Professor Pearson's indefatigable researches in the new science of Biometry—especially in the development of Statistical Theory.

The publishers, also, of this book are deserving of credit for the courage they have shown in reproducing expensive tables for the use of a still very limited body of statistical workers. Especial attention is called to Table IV, which is an extension of Table IV of the first edition that was calculated by Professor Frederick H. Safford, and appears to have been the first published table of the normal probability integrals based on the standard deviation. More recently Mr. W. F. Sheppard has published in Biometrika a similar table in which, however, the tabular entries are given to seven places of decimals, while the arguments are given to two decimal places only. In the present table the arguments are subdivided to three places of decimals and with the aid of the table of proportional parts interpolation is easily effected.

Especial acknowledgment must be made of assistance received from my friend Mr. F. E. Lutz, who read over the entire manuscript and contributed certain of the numerical examples.

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COLD SPRING HARBOR,
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STATISTICAL METHODS

WITH SPECIAL REFERENCE TO

BIOLOGICAL VARIATION.

CHAPTER I.

ON METHODS OF MEASURING ORGANISMS.

Preliminary Definitions.

An *individual* is a segregated mass of living matter, capable of independent existence. Individuals are either simple or compound, *i.e.*, stocks or corms. In the case of a compound individual the morphological unit may be called a *person.*

A *multiple organ* is one that is repeated many times on the same individual. Example, the leaves on a tree, the scales on a fish.

A *character* is any quality common to a number of individuals or to a number of multiple organs of one individual.

A *variate* is a single magnitude-determination of a character.

Integral variates are magnitude-determinations of characters which from their nature are expressed in integers. Such magnitudes are expressed by counting; *e.g.*, the number of teeth in the porpoise. These are also called *discontinuous.*

Graduated variates are magnitude-determinations of characters which do not exist as integers and which may consequently differ in different variates by any degree of magnitude however small; *e.g.*, the stature of man.

A *variant*, among integral variates, is a single number-condition, *e.g.*, 5 (flowers), 13 (ray-flowers), etc.

A *class*, among graduated variates, includes variates of the same or nearly the same magnitude. The *class range* gives the limits between which the variates of any class fall.

Individual variation deals with diversity in the characters of individuals.

Organ variation, or partial variation, deals with diversity in multiple organs in single individuals.

Methods of Collecting Individuals for Measurement.

In collecting a lot of individuals for the study of the variability of any character undue selection must be avoided. The rule is:

Having settled upon the general conditions, of race, sex, locality, age, *which the individuals to be measured must fulfil, take the individuals methodically at random and without possible selection of individuals on the basis of the magnitude of the character to be measured.* If the individuals are simply not consciously selected on the basis of magnitude of the character they will often be taken sufficiently at random.

The *number* of variates to be obtained should be large; if possible from 200 to 2000, depending on abundance and variability of the material.

Processes Preliminary to Measuring Characters.

Some characters can best be measured directly; *e.g.*, the stature of a race of men. Often the character can be better studied by reproducing it on paper. The two principal methods of reproducing are by photography and by camera drawings.

For *photographic reproductions* the organs to be measured will be differently treated according as they are opaque or transparent. Opaque organs should be arranged if possible in large series on a suitable opaque or transparent background. The prints should be made on a rough paper so that they can be written on; blue-print paper is excellent. This method is applicable to hard parts which may be studied dry; *e.g.*, mollusc shells, echinoderms, various large arthropods, epidermal markings of vertebrates and parts of the vertebrate skeleton. Shadow photographs may be made of the outlines of opaque objects, such as birds' bills, birds' eggs, and butterfly wings, by using parallel rays of light and interposing the object between the source of light * and the photo-

* A Welsbach burner or an electric light are especially good. Minute

graphic paper. More or less transparent organs, such as leaves, petals, insect-wings, and appendages of the smaller Crustacea, may be reproduced either directly on blue-print paper or by "solar prints," either of natural size or greatly enlarged. For solar printing the objects should be mounted in series on glass plates. They may be fixed on the plate by means of balsam or albumen and mounted between plates either dry or in Canada balsam or other permanent mounting media. Wings of flies, orthoptera, neuroptera, etc., may be prepared for study in this way; twenty-five to one hundred sets of wings being photographed on one sheet of paper, say 16 × 20 inches in size. Microphotographs will sometimes be found serviceable in studying small organisms or organs, such as shells of Protozoa or cytological details.

Camera drawings are a convenient although slow method of reproducing on paper greatly enlarged outlines of microscopic characters, such as the form and markings of worms and lower Crustacea, sponge spicules, bristles, scales and scutes, plant-hairs, cells and other microscopic objects. In making such camera drawings a low-power objective, such as Zeiss A*, will often be found very useful.

The Determination of Integral Variates.—Methods of Counting.

While the counting of small numbers offers no special difficulty, the counting becomes more difficult with an increase of numbers. To count large numbers the general rule is to divide the field occupied by the numerous organs into many small fields each containing only a few organs. Counting under the microscope, *e.g.*, the number of spines, scales or plant-hairs per square millimetre, may be aided by cross-hair rectangles in the eyepiece. The number of blood-corpuscles in a drop of blood, or of organisms in a cubic centimetre of water, have long been counted on glass slides ruled in small squares.

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electric lamps such as are fed by a single cell give sharp shadows of small objects.

The Determination of Graduated Variates.—Methods of Measurement.

Straight lines on a plane surface are easily measured by means of a measuring-scale of some sort. The measurement should always be metric because this is the universal scientific system. Various kinds of scales may be obtained of optical companies and hardware dealers,—such as steel measuring-tapes, graduated to millimetres (about $1.00), and steel rules (6 cm. to 15 cm.) graduated to $\frac{1}{5}$ of a millimetre. Steel "spring-bow" dividers with milled-head screw are useful for getting distances which may be laid off on a scale. **Tortuous lines,** *e.g.*, the contour of the serrated margin of a leaf or the outer margin of the wing of a sphinx moth, may be measured by a map-measurer ("Entfernungsmesser," Fig. 1), supplied at artist's and engineer's supply stores at about $3.50.

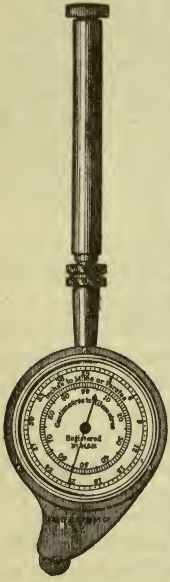

FIG. 1.

Distances through solid bodies or cavities are measured by calipers of some sort. Calipers for measuring diameters of solid bodies are made in various styles. Micrometer screw calipers ("speeded") reading to one-hundredths of a millimetre and sold by dealers in physical apparatus for about $5.00 are excellent for determining diameters of bones, birds' eggs, gastropod shells, etc. Leg calipers for rougher work can be obtained for from 30 cents to $4.00. The micrometer "caliper-square," available for inside or outside measurements and measuring to hundredths of a millimetre, is a useful instrument.*

The **area of plane surfaces,** as, *e.g.*, of a wing or leaf, is easily determined by means of a sheet of colloidin scratched in millimetre squares. By rubbing in a little carmine the

* Many of the instruments described in this section are made by the Starrett Co., Athol, Mass., and by Brown and Sharpe, Providence, tool cutters.

scratches may be made clearer. The number of squares covered by the surface is counted (fractional squares being mentally summated) and the required area is at once obtained. If the area has been traced on paper it may be measured by the planimeter (Fig. 2). This instrument may be obtained at

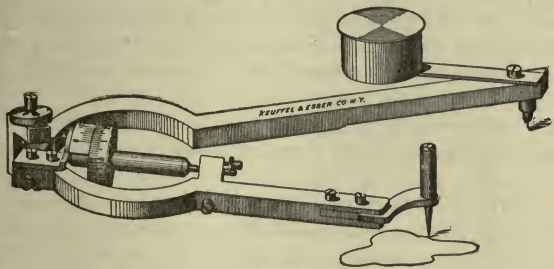

FIG. 2.

engineer's supply shops. It consists of two steel arms hinged together at one end; the other end of one arm is fixed by a pin into the paper, the end of the second arm is provided with a tracer. By merely tracing the periphery of the figure whose area is to be determined the area may be read off from a drum which moves with the second arm. This method is less wearisome than the method of counting squares.

The area of a curved surface, like that of the elytra of a beetle or the shell of a clam, is not always easy to find. To get the area approximately, project the curved surface on a plane by making a camera drawing or photograph of its outline. By means of parallel lines divide the outline drawing into strips such that the corresponding parts of the curved surface are only slightly curved across the strips, but greatly curved lengthwise of the strips. Measure the length of each plane strip and divide the magnitude by the magnification of the drawing. Measure also, with a flexible scale, the length of the corresponding strip on the curved surface. Then, the area of any strip of the object is to the area of the projection as the length of the strip on the object is to the length of its projection. The sum of the areas of the strips will give the total area of the surface.

Characters occupying three dimensions of space may be quantitatively expressed by volume. The volume of water or sand displaced may be used to measure volume in the case of solids. The volume of water or sand contained will measure a cavity. Irregular form is best measured by getting, either by means of photography or drawings, projections of the object on one or more of the three rectangular fundamental planes of the organ, and then measuring these plane figures as already described. Or two or more axes may be measured and their ratio found.

Characters having weight are easily measured; the only precautions being those observed by physicists and chemists.

Color Characters. Color may be qualitatively expressed by reference to named standard color samples. Such standard color samples are given in Ridgeway's book, "Nomenclature of Color," and also in a set of samples manufactured by the Milton Bradley Co., Springfield, Mass., costing 6 cents. The best way of designating a color character is by means of the color wheel, a cheap form of which (costing 6 cents) is made by the Milton Bradley Co. The colors of this "top" are standard and are of known wave-length as follows:

Red,	656 to 661	Green,	514 to 519
Orange,	606 to 611	Blue,	467 to 472
Yellow,	577 to 582	Violet,	419 to 424.

It is desirable to use Milton Bradley's color top as a standard. Any color character can be matched by using the elementary colors and white and black in certain proportions. The proportions are given in percents. In practice the fewest possible colors necessary to give the color character should be employed and two or three independent determinations of each should be made at different times and the results averaged. So far as my experience goes any color character is given by only one least combination of elementary colors. (See *Science*, July 16, 1897.)

When there is a complex **color pattern** the color of the different patches must be determined separately. In case of a close intermingling of colors, the colored area may be rapidly rotated on a turntable so that the colors blend and the result-

ant may then be compared with the color wheel. By this means also the total melanism or albinism, viridescence, etc., may be measured.

Marking-characters. The quantitative expression of markings or color patterns will often call for the greatest ingenuity of the naturalist. Only the most general rules can here be laid down. Study the markings comparatively in a large number of the individuals, reduce the pattern to its simplest elements, and find the law of the qualitative variation of these elements. The variation of the elements can usually be treated under one of the preceding categories. Find in how far the variation of the color pattern is due to the variation of some number or other magnitude, and express the variation in terms of that magnitude. Remember that it is rarely a question whether the variation of the character can be expressed quantitatively but rather what is the best method of expressing it quantitatively.

Aids in Calculating. An indispensable aid in multiplying and dividing is a book of reckoning tables of which Crelle's Rechnungstafeln (Berlin: Geo. Reimer) is the best. This work enables us to get directly any product to 999×999 and indirectly, but with great rapidity, any higher product or any quotient.

The tables of Barlow ("Tables of Squares, Cubes, Square Roots, Cube Roots, and Reciprocals of all Integer Numbers up to 10,000") are like our Table X, but more extended.

The tedious work of adding columns of numbers is greatly simplified by the use of some one of the better adding machines. There are many forms, of which the best are made in the United States. The author has used the "Comptometer" made by the Felt and Tarrent Manufacturing Co., Chicago ($225), and found it perfectly satisfactory. This machine is manipulated by touching keys, as in a typewriter, but it does not print the numbers touched off. In this respect it is inferior to the Burroughs Adding Machine of the American Arithometer Co., St. Louis, Mo., which costs $250 to $350, or to the Standard Adding Machine, St. Louis ($185).

For the multiplication and division of large numbers the Baldwin Calculator is well spoken of (*Science*, XVII, 706). It is sold by the Spectator Company, 95 William Street, New York, price $250. The same firm is agent for Tate's Im-

proved Arithometer ($300 to $400). The "Brunsviga" calculating machine (Herrn Grimme, Natalis & Co., Brunswick, Germany, Manufacturers; price $140 to $75) is highly recommended by Pearson.

To draw logarithmic curves and for the mechanical solution of arithmetical problems the instrument of Brooks (*Science*, XVII, 690, not yet marketed) should be found useful.

Precautions in Arithmetical Work. Even the most careful computers make mistakes in arithmetical work. It is absolutely necessary to take such precautions that errors may be detected. The best method is for statistical workers to compute in pairs, but absolutely independently, comparing results as the work progresses, so that time shall not be wasted by elaborate work done with erroneous values. In case of disagreement both workers should recompute, starting from that point of the work where their results check. In cases where it is not feasible for the work to be done by two people, it should be calculated on distinct pages of the notebook—proceeding through several steps on the one page and then independently through the same steps on another page; checking the work as it progresses. It will be found useful as the work progresses to make rough checks by comparing the results with the original data to see that the results are probable.

Neatness in arrangement of work and in the making of figures is essential. It is best to make *all* calculations in a book with pages about 20 cm. by 30 cm., quadruple ruled, with about three squares to the centimetre, so that each figure may occupy a distinct square. I like to work with a pencil, of 2H grade, so that slight errors may be erased and rectified. In case of larger errors running through several steps of the work, the erroneous calculations should not be erased but cancelled.

In using logarithms with the six-place table given in this book, it is ordinarily necessary to write the entire mantissa to six places, and to determine the number corresponding to any logarithm to at least six places by use of the table of proportional parts given at the bottom of the page. Upon the completion of the calculation the number of decimal places to be recorded will depend upon the probable error of

each constant. It will ordinarily suffice if the probable error contain two significant figures, *e.g.*, ± 0.17 or ± 0.0089; then the constant will be carried out to the same number of places and not farther.

CHAPTER II.

On the Seriation and Plotting of Data and the Frequency Polygon.

The data obtained by measuring any character in a lot of individuals consists either of a mass of numbers for the character in each individual ; or, perhaps, two numbers which are to be united to form a ratio ; or, finally, a series of numbers such as are obtained by the color wheel, of the order : *W* 40%, *N* (Black) 38%, *Y* 12%, *G* 10%. The first operation is the simplification of data. Each variate must be represented by one number only. Consequently, quotients of ratios must be determined and that single color of a series of colors which shows most variability in the species must be selected, *e.g.*, *N*.

The process of seriation, which comes next, consists of the grouping of similar magnitudes into the same magnitude class. The classes being arranged in order of magnitude, the number of variates occurring in each class is determined. The number of variates in the class determines the *frequency* of the class. Each class has a *central value*, an *inner* and an *outer limiting* value, and a certain *range* of values.

The method of seriation may be illustrated by two examples ; one of integral variates, and the other of graduated variates.

Example 1. The magnitude of 21 integral variates are found to be as follows : 12, 14, 11, 13, 12, 12, 14, 13, 12, 11, 12, 12, 11, 12, 10, 11, 12, 13, 12, 13, 12, 12. In seriation they are arranged as follows :

Classes :	10,	11,	12,	13,	14.
Frequency :	1,	4,	11,	4,	2.

Example 2. In the more frequent case of graduated variates our magnitudes might be more as follows :

3.2	4.5	5.2	5.6	6.0
3.8	4.7	5.2	5.7	6.2
4.1	4.9	5.3	5.8	6.4
4.3	5.0	5.3	5.8	6.7
4.3	5.1	5.4	5.9	7.3

In this case it is clear that our magnitudes are not exact, but are merely approximations of the real (forever unknowable) value. The question

arises concerning the inclusiveness of a class—the *class range*. An approximate rule is: Make the classes only just large enough to have no or very few vacant classes in the series. Following this rule we get

Classes....	3.0–3.4;	3.5–3.9;	4.0–4.4;	4.5–4.9;	5.0–5.4;
	3.2	3.7	4.2	4.7	5.2
	1	2	3	4	5
Frequency	1	1	3	3	7
Classes....	5.5–5.9;	6.0–6.4;	6.5–6.9;	7.0–7.4;	
	5.7	6.2	6.7	7.2	
	6	7	8	9	
Frequency	5	3	1	1	

The classes are named from their middle value, or better, for ease of subsequent calculations, by a series of small integers (1 to 9).

In case the data show a tendency of the observer towards estimating to the nearest round number, like 5 or 10, each class should include one and only one of these round numbers.

As Fechner ('97) has pointed out, the frequency of the classes and all the data to be calculated from the series will vary according to the point at which we begin our seriation. Thus if, instead of beginning the series with 3.0 as in our example, we begin with 3.1 we get the series:

Classes	3.1–3.5;	3.6–4.0;	4.1–4.5;	4.6–5.0;	5.1–5.5;
	3.3	3.8	4.3	4.8	3.5
Frequency	1	1	4	3	6
Classes	5.6–6.0;	6.1–6.5;	6.6–7.0;	7.1–7.5;	
	5.8	6.3	6.8	7.3	
Frequency	6	2	1	1	

which is quite a different series. Fechner suggests the rule: Choose such a position of the classes as will give a most normal distribution of frequencies. According to this rule the first distribution proposed above is to be preferred to the second.

In order to give a more vivid picture of the frequency of the classes it is important to plot the frequency polygon. This is done on coordinate paper.*

The best method, especially when the number of classes is less than 20, is to represent the frequencies by rectangles of equal base and of altitude proportional to the frequencies. Lay off along a horizontal line equal contiguous spaces each of which shall represent one class, number the spaces in order from left to right with the class magnitudes in succession, and erect upon these bases rectangles proportionate in height to the frequency of the respective classes (Fig. 3).

* This paper may be obtained at any artists' supply store.

This method of drawing the frequency polygon is known as the **method of rectangles.**

When the number of classes is large the frequencies may be represented by ordinates as follows: At equal intervals along

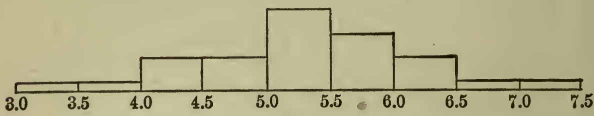

FIG. 3.

a horizontal line (axis of X) draw a series of (vertical) ordinates whose successive heights shall be proportional to the frequency of the classes. Join the tops of the ordinates as shown in Fig. 4. This method of drawing the frequency polygon is known as the **method of loaded ordinates.**

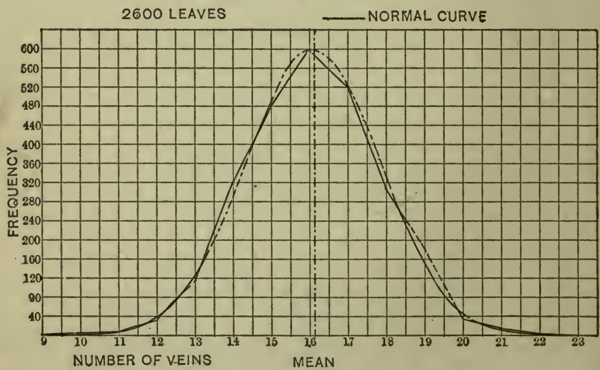

FIG. 4.—VEINS IN BEECH LEAVES, AFTER PEARSON, '02*i*.

The rejection of extreme variates in calculating the constants of a distribution polygon is to be done only rarely and with caution. In many physical measurements Chauvenet's criterion is used to test the suspicion that a single extreme variant should be rejected. A limiting deviation ($\kappa\sigma$) is calculated. κ is the argument in Table IV corresponding to a tabular entry equal to $\frac{2n-1}{4n}$.

EXAMPLE.—In 1000 minnows from one lake there are found the following frequencies of anal fin-rays:

7	8	9	10	11	12	13
1	2	15	279	554	144	5

$$A=10.835;\quad \sigma=.728 \text{ fin-rays.}$$

$$\kappa=\frac{1999}{4000}=.49975.$$

Looking in Table IV we find 3.48 corresponding to the entry 49975. Then the limiting deviation $=3.48\times.728=2.5334$ and the limiting class is $10.835-2.533=8.302$; hence the observation at 7 might be excluded in calculating the constants of the seriation; but it should not be suppressed in publishing the data.

Certain Constants of the Frequency Polygon.

After the data have been gathered and arranged it is necessary to determine the law of distribution of the variates. To get at this law we must first determine certain constants.

The **average** or **mean** (A) is the abscissa of the centre of gravity of the frequency polygon. It is found by the formula

$$A=\frac{\Sigma(V\,.\,f)}{n},$$

in which V is the magnitude of any class; f its frequency; Σ indicates that the sum of the products for all classes into frequency is to be got, and n is the number of variates.

Thus in the example on p. 10:

$$A=(3.2\times1+3.7\times1+4.2\times3+4.7\times3+5.2\times7+5.7\times5+6.2\times3+6.7\times1+7.2\times1)\div25=5.24,$$

or

$$A_1=(1\times1+2\times1+3\times3+4\times3+5\times7+6\times5+7\times3+8\times1+9\times1)\div25=5.08,$$

$$A=5.2^*+.08(5.7-5.2)=5.24.$$

A still shorter method of finding A is given on page 20.

The **mode** (M) is the class with the greatest frequency. It is necessary to distinguish sharply between the empirical and the theoretical mode. The *empirical mode* is that mode which is found on inspection of the seriated data. In the example, the empirical mode is 5.2. The *theoretical mode* is the mode of the theoretical curve most closely agreeing with the observed distribution. Pearson 1902[b], p. 261) gives this

* 5.2 is the true class magnitude corresponding to the integer 5.

rule for roughly determining the theoretical mode. The mode lies on the opposite side of the median from the mean; and the abscissal distance from the median to the mode is double the distance from the median to the mean; or, mode = mean $-3\times$(mean − median). More precise directions for finding the mode in the different types of frequency polygons are given in the discussion of the types.

The **median magnitude** is one above which and below which 50% of the variates occur. It is such a point on the axis of X of the frequency polygon that an ordinate drawn from it bisects the polygon of rectangles or the continuous curve, but not the polygon of loaded ordinates.

To find its position: *Divide the variates into three lots: those less than the middle class*, i.e., *the one that contains the median magnitude, of which the total number is a; those of the middle class, b; and those greater, c. Then* $a+b+c=n=$ *the total number of variates. Let* $l'=$ *the lower limiting value of the middle class, and* $l''=$ *the upper limiting value, and let* $x=$ *the abscissal distance of the median ordinate above the lower limit or below the upper limit of the median class according as x is positive or negative. Then* $\frac{1}{2}n-a : b = x : l''-l'$ *when x is positive, or* $\frac{1}{2}n-c : b = x : l''-l'$ *when x is negative.*

Thus in the last example: $(12.5-8):7=x:0.5$; $x=.32$; the median magnitude $=5.0+.32=5.32$. Or $(12.5-10):7=-x:0.5$; $x=-.18$; the median magnitude $=5.5-.18=5.32$. (Cf. p. 10.)

The **probable error** (E) **of the determination** of any value gives the measure of unreliability of the determination; and it should always be found. For, any determination of a constant of a frequency polygon is only an approximation to the truth. The probable error (E) is a pair of values lying one above and the other below the value determined. We can say that there is an even chance that the true value lies between these limits. The chances that the true value lies within:*

$\pm 2E$ are 4.5:1	$\pm 5E$ are 1,310:1
$\pm 3E$ are 21 :1	$\pm 6E$ are 19,200:1
$\pm 4E$ are 142 :1	$\pm 7E$ are 420,000:1

$\pm 8E$ are 17,000,000:1

$\pm 9E$ are about a billion to 1.

The probable error should be found to two significant

* These values are easily deduced from Table IV.

figures. The determination of which it is the error should be carried out to the same number of places as the probable error and no more.

The **probable difference** between two averages (A_1 and A_2) of which the probable errors (E_1 and E_2) are known is the square root of the sum of the squared probable errors, or (Pearson, '02):

$$\text{Probable Difference of } A_1 - A_2 \text{ is } \sqrt{E_1^2 + E_2^2}.$$

The **probable error of the mean** is given by the formula

$$\pm 0.6745 \times \frac{\text{standard deviation [see below]}}{\sqrt{\text{number of variates}}} = \pm 0.6745 \frac{\sigma}{\sqrt{n}}.$$

It will be seen that the probable error is less, that is, that the result is more accurate, the greater the number of variates measured, but the accuracy does not increase in the same ratio as the number of individuals measured, but as the square root of the number. The probable error of the mean decreases as the standard deviation decreases.

The **probable error of the median** is $\pm .84535\sigma \div \sqrt{n}$ (Sheppard, '98).

The **geometric mean** of a series of values (v) is the number corresponding to the average of the logarithms of the values. Thus,

$$G = N \frac{\Sigma\,(\log v)}{n}.$$

The **index of the variability,** σ, of the variates when they group themselves about one mode is found by adding the products of the squared deviation-from-the-mean of each class multiplied by its frequency, dividing by the total number of variates, and extracting the square root of the quotient, thus:

$$\sigma = \sqrt{\frac{\text{sum of [(deviation of class from mean)}^2 \times \text{frequency of class]}}{\text{number of variates}}} \times \lambda$$

$$= \sqrt{\frac{\Sigma (x^2 . f)}{n}} \times \lambda;$$

where λ is the number of units in the class range, frequently unity.

This measure is known as the **standard deviation.** It is a concrete number expressed in the units of the classes. This, the best measure of variability, is expressed geometrically as the half parameter, or the abscissa of the point on the frequency curve where the change of curvature (from concave to convex toward the centre) occurs.

The **probable error of the standard deviation** is

$$\pm 0.6745 \frac{\text{standard deviation}}{\sqrt{2 \times \text{number of variates}}} = \pm 0.6745 \frac{\sigma}{\sqrt{2n}}.$$

Other Indices of Variation. The average deviation, or **average departure,** is found thus:

$$\text{A.D.} = \frac{\text{sum of [deviations of class from mean} \times \text{frequency]}}{\text{number of variates}}.$$

The average deviation is equal to .7979×standard deviation, or $=0.7979\sigma$.

The **probable** (or mid) **departure** is the distance from the mode of that ordinate which exactly bisects the half curve $0MX$ or $0MX^1$, Fig. 5, it is equal to 0.6745×standard deviation$=0.6745\sigma$. Neither of these last two indices of variation is as good as the standard deviation when n is rather small.

The standard deviation, like the other indices of variation, is a concrete number, being expressed in the same units as the magnitudes of the classes. The standard deviation of one lot of variates is consequently not comparable with the S. D. of variates measured in other units. It has been proposed to reduce the index of variation to an abstract number, independent of any particular unit, by dividing the index of variation of any variates by the mean; the quotient multiplied by 100 is called the **coefficient of variability.** In a formula, $C = \frac{\sigma}{A} \times 100\%$ (Pearson, '96; Brewster, '97).

The **probable error of the coefficient of variability** is given by Pearson as:

$$E_C = .6745 \frac{C}{\sqrt{2n}} \left[1 + 2\left(\frac{C}{100}\right)^2\right]^{\frac{1}{2}}.$$

When C is small, say less than 10%, the factor in brackets may be omitted, especially as only two significant figures of the probable error need be recorded.

The average, standard deviation, coefficient of correlation, and their probable errors may be conveniently calculated altogether by logarithms, as shown in the paradigm on page 38.

Quick Methods of Roughly Determining Average and Variability.*

1. Arrange the specimens in a series according to the magnitude of the character, simply judging the order by the eye. Then pick out those two that will divide the series into thirds and measure them. Their average will be the average of the whole series. Then,

$$\frac{\text{Mean} - \text{the smaller of the two measures}}{.43} = \sigma.$$

(.43 is the value of $\pm \frac{x}{\sigma}$, at which the area of the curve included between these limits of x equals one-third of the whole).

Or, 2. Select roughly two specimens that seem to be about one-third of the distance from the two extremes and group all others as larger than the larger one, smaller than the smaller one, or between the two. Measure the two specimens. Count the number in each group and determine σ by aid of Table IV (p. 120) as follows: Taking as origin the middle of the whole series, call the number of leaves from the middle to the smaller n_2', and the number from the middle to the larger n_2''. Also, the x distance to the lower division point h_1 and to the upper division point h_2. Then $(h_1 + h_2) =$ the range covered by the middle division or the difference between the upper and lower value. As we know the areas of the curve between the origin and h_1 on the one hand and h_2 on the other (percentage of individuals between the middle and h_1 and h_2), we can find $\frac{h_1}{\sigma}$ and $\frac{h_2}{\sigma}$ from Table IV, since they are the values $\frac{x}{\sigma}$ corresponding to the percentage

* See Macdonell, 1902.

areas determined. But $\frac{h_1}{\sigma}+\frac{h_2}{\sigma}=\frac{(h_1+h_2)}{\sigma}$; thus σ is determined. Knowing σ we can get h_1 or h_2, and hence the mean. Or the value of the character of the middle specimen may be taken as the mean value.

EXAMPLE.—Seventy-six beech-leaves which had fallen from one tree were picked up. They were sorted out as in the second method. It was found that 22 were smaller than the smaller type leaf, which was 1.78 inches in length; and 23 were larger than the larger type leaf (2.22 inches in length). The 38th leaf is the middle of the series, and so the smaller type leaf was distant 16 leaves from the middle, and the larger 15.

$$\frac{n_2'}{n}=\frac{16}{76}=.2105; \qquad \frac{n_2''}{n}=\frac{15}{76}=.1974.$$

From Table IV:

$\frac{h_1}{\sigma}$	% area.
.56	.21226
.55	.20884

Therefore $\frac{h_1}{\sigma}=.555.$

Similarly $\frac{h_2}{\sigma}=.517$;

$$\frac{h_1+h_2}{\sigma}=1.072=\frac{2.22-1.78}{\sigma}.$$

$$\therefore\ \sigma=\frac{.44}{1.072}=.4105;$$

$$\frac{h_1}{.4105}=.555; \qquad \frac{h_2}{.4105}=.517;$$

$$h_1=.2278, \qquad h_2=.2122.$$

Mean is at $1.78+.2278=2.01$.

CHAPTER III.

The Classes of Frequency Polygons.

The plotted curve may fall into one of the following classes:

A. Unimodal.

- I. Simple.
  1. Range unlimited in both directions:
     - *a*. Symmetrical. The normal curve.
     - *b*. Unsymmetrical (Pearson's Type IV).
  2. Range limited in one direction, together with skewness (Types III, V, and VI).
  3. Range limited in both directions:
     - *a*. Symmetrical, Type II.
     - *b*. Unsymmetrical, Type I.
- II. Complex.

B. Multimodal.

The classification of any given curve is not always an easy task. Whether the curve is unimodal or multimodal can be told by inspection. Whether any unimodal curve is simple or complex cannot be told by any existing methods without great labor and uncertainty in the result.

Complex curves may be classified as follows:

1. Composed of two curves, whose modes are different but so near that the component curves blend into one; such curves are usually unsymmetrical.

2. The sum of two curves having the same mode but differing variability.

3. The difference of two curves having the same mode but differing variability.

If the material is believed to be *homogeneous* and the curve is unimodal it is probably *simple* and its classification may be carried further.

For classification the rule is as follows: Determine the mean of the magnitudes. Take a class near the mean (call it V_0)

as a zero point; then the departure of all the other classes will be -1, -2, -3, etc., and $+1$, $+2$, $+3$, etc.

Add the products of all these departures multiplied by the frequency of the corresponding class and divide by n; call the quotient ν_1.

Add the products of the *squares* of all the departures multiplied by the frequency of the corresponding class and divide by n; call the quotient ν_2.

Add the products of the *cubes* of all the departures multiplied by the frequency of the corresponding class and divide by n; call the quotient ν_3.

Add the products of the *fourth powers* of all the departures multiplied by the frequency of the corresponding class and divide by n; call the quotient ν_4. Or,

$\nu_1=\frac{\Sigma(V-V_0)}{n}=$ departure of V_0 from mean. V_0 being known, A may be found $[A=V_0+\nu_1]$;*

$$\nu_2=\frac{\Sigma(V-V_0)^2}{n};$$

$$\nu_3=\frac{\Sigma(V-V_0)^3}{n};$$

$$\nu_4=\frac{\Sigma(V-V_0)^4}{n}.$$

The values ν_1, ν_2, ν_3, ν_4, are called respectively the first, second, third, and fourth moments of the curve about V_0.

To get the moments of the curve about the mean, either of two methods (A or B) will be employed. Method A is used when integral variates are under consideration; method B when we deal with graduated variates.

(A) To find moments in case of integral variates:

$$\mu_1=0;$$

$$\mu_2=\nu_2-\nu_1^2;\ E_{\mu_2}=.67449\sqrt{\frac{\mu_4-\mu_2^2}{n}};$$

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* This is the short method of finding A referred to on page 13.

$\mu_3=\nu_3-3\nu_1\nu_2+2\nu_1^3;\quad E_{\mu_3}=T\sqrt{\dfrac{\mu_6-\mu_3^2-6\mu_4\mu_2+9\mu_2^3}{n}};$

$\mu_4=\nu_4-4\nu_1\nu_3+6\nu_1^2\nu_2-3\nu_1^4;\ E_{\mu_4}=T\sqrt{\dfrac{\mu_8-\mu_4^2-8\mu_5\mu_3+16\mu_2\mu_3^2}{n}};$

$\mu_5=\nu_5-5\nu_1\nu_4+10\nu_1^2\nu_3-10\nu_1^3\nu_2+4\nu_1^5;$

$\mu_6=\nu_6-6\nu_1\nu_5+15\nu_1^2\nu_4-20\nu_1^3\nu_3+15\nu_1^4\nu_2-5\nu_1^6.$

(B) To find moments in case of graduated variates:

$\mu_1'=0;$
$\mu_2'=[\nu_2-\nu_1^2-\frac{1}{12}]\lambda^2;$
$\mu_3'=[\nu_3-3\nu_1\nu_2+2\nu_1^3]\lambda^3;$
$\mu_4'=[\nu_4-4\nu_1\nu_3+6\nu_1^2\nu_2-3\nu_1^4-\frac{1}{2}(\nu_2-\nu_1^2)+\frac{7}{240}]\lambda^4;$
$\mu_5'=[\nu_5-5\nu_1\nu_4+10\nu_1^2\nu_3-10\nu_1^3\nu_2+4\nu_1^5-\frac{5}{6}\mu_3]\lambda^5;$
in which λ is the class range expressed in the same unit as the average.

Also, $\beta_1=\dfrac{\mu_3^2}{\mu_2^3};\quad \beta_2=\dfrac{\mu_4}{\mu_2^2}.$

The probable error of the preceding constants in the special case of the normal curve is as follows:

$$E\mu_2=.67449\sigma^2\sqrt{\frac{2}{n}};\qquad E\beta_2=.67449\sqrt{\frac{24}{n}};$$

$$E\mu_3=.67449\sigma^3\sqrt{\frac{6}{n}};\qquad E\sqrt{\beta_1}=.67449\sqrt{\frac{6}{n}};$$

$$E\mu_4=.67449\sigma^4\sqrt{\frac{96}{n}};\qquad E\bar{D}=.67449\sqrt{\frac{3}{2n}}\sigma\ \text{(p. 31)};$$

$$E \text{ of Skewness}=.67449\sqrt{\frac{3}{2n}}.\quad \text{(See page 30.)}$$

(From Pearson, 1903[c]).

The classification of any empirical frequency polygon depends upon the value of its "critical function," F* (Pearson, 1901[d]).

$$F=\frac{\beta_1(\beta_2+3)^2}{4(4\beta_2-3\beta_1)(2\beta_2-3\beta_1-6)}.$$

* This value of F is general. For the special case of Types I–IV the following critical function was given by Pearson and has been

Value of F.	Corresponding Frequency Curve.
$F=\infty$	Type III. Transitional between Type I and Type VI.
$F>1$ and $<\infty$	Type VI.
$F=1$	Type V. Transitional between Type IV and Type II.
$F>0$ and <1	Type IV.
$F=0$, $\beta_1=0$, $\beta_2=3$	Normal curve.
$F=0$, $\beta_1=0$, β_2 not$=3$	Type II.
$F<0$	Type I.

An important relation to be referred to later is

$$s=\frac{6(\beta_2-\beta_1-1)}{3\beta_1-2\beta_2+6}.$$

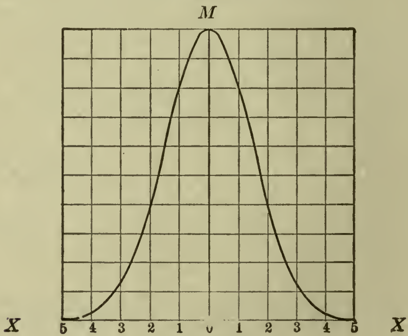

FIG. 5.

THE NORMAL CURVE.

The **normal curve** is symmetrical about the mode; consequently the mode and the median and mean coincide.

The mathematical formula of the normal curve, a formula

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much used. $F_1=2\beta_2-3\beta_1-6$. The classification was given as follows:

When F is negative and $\begin{cases}\beta_1>0, \text{ curve is of Type I.}\\ \beta_1=0,\ \beta_2<3, \text{ curve is of Type II.}\end{cases}$

When $F=0$ and $\begin{cases}\beta_1>0,\ \beta_2>3, \text{ curve is of Type III.}\\ \beta_1=0,\ \beta_2=3, \text{ curve is normal.}\end{cases}$

When F is positive and $\beta_1>0$, $\beta_2>3$, curve is of Type IV.

of which one does not have to understand the development in order to make use of it, is

$$y=\frac{n}{\sigma\sqrt{2\pi}}\cdot\frac{1}{e^{x^2/2\sigma^2}}.$$

This formula gives the value of any ordinate y (or any class) at any distance x (measured along the base, X, X', of Fig. 5) from the mode. e is a constant number, 2.71828, the base of the Naperian system of logarithms. n is the total area of the curve or number of variates, and σ is the Standard Deviation, which is constant for any curve and measures the variability of the curve, or the steepness of its slope.

To compare any observed curve with the theoretical normal curve we can make use of tables. For the case of a polygon of loaded ordinates the theoretical frequency of any class at a deviation $\frac{x}{\sigma}$ from the mean can be taken directly from Table III. Here $\frac{x}{\sigma}$ is the actual deviation from the mean expressed in units of the standard deviation, and $\frac{y}{y_0}$ the corresponding ordinate, y_0 being taken as equal to 1, and σ is the standard deviation.

For the case of a polygon built up of rectangles representing the relative frequency of the variates, Table IV gives immediately the theoretical number of individuals occurring between the values $x=0$ and $x=\pm\frac{x}{\sigma}$. By looking up the given values of $\frac{x}{\sigma}$ the corresponding theoretical percentage of variates between the limits $x=0$ and $x=\pm\frac{x}{\sigma}$ will be found directly. The ratio $\frac{x}{\sigma}$ may be called the *Index of Abmodality.*

The normal curve may preferably be employed even when β_1 is not exactly equal to 0, nor β_2 exactly equal to 3, nor F exactly equal to 0. Use the normal curve when

$$F\times\mu_2^3<\pm 1 \quad \text{and} \quad \frac{3\nu_2^2-2\nu_1^4}{\nu_4}=1\pm .2;$$

also the skewness (p. 30) should be less than twice the value $.67449 \sqrt{\frac{3}{2n}}$.

To determine the closeness of fit of a theoretical polygon to the observed polygon. Find for each class the difference (δ_1) between the theoretical value (y) and the observed frequency (f). Divide the square of this difference in each case by y. The square root of the sum of the quotients is the index of closeness of fit (Δ). Or, $\Delta = \sqrt{\Sigma \frac{\delta_1^2}{y}}$. The probability ($P:1$) that the observed distribution is truly represented by the theoretical polygon may be calculated from the following formula, to use which the number of classes (A) must be odd or must be made odd by the addition of a class with 0 frequency.

$$P = e^{-\frac{1}{2}\Delta^2}\left(1+\frac{\Delta^2}{2}+\frac{\Delta^4}{2.4}+\frac{\Delta^6}{2.4.6}+\ldots+\frac{\Delta^{A-3}}{2.4.6\ldots A-3}\right).$$

This is the method of Pearson, 1900[b].

To determine the probability of a given distribution being normal. Having found, in units of the standard deviation, the deviation (χ) of the inner limiting value (L) of each class from the average, look up the corresponding class-index a from Table IV. Or, better, find a directly for each class by dividing the half of the total number of variates minus all those lying beyond the inner limiting value of the class in question by the half of the total number of variates; or, in a formula, $\frac{\Sigma_0{}^{\chi}f}{\frac{1}{2}n}$; where $\Sigma_0{}^{\chi}f$ means add all the frequencies from the median value to χ, and n is the number of variates. Next find for each class the sum of $A+\sigma\chi$. This should equal L. The difference is the *actual discrepancy*. The *probable discrepancy* should next be calculated for all but the extreme values. It is calculated by use of the formula

$$0.6745\sigma\left\{\frac{\pi(1-a^2)}{2z^2}-\left(1+\frac{\chi^2}{2}\right)\right\}^{\frac{1}{2}}\div\sqrt{n},$$

where the value of z corresponding to χ is got from Table III, or from the formula

$$e^{-\frac{1}{2}\chi^2}=\frac{1}{e^{\frac{1}{2}\chi^2}}.$$

The ratio of actual to probable discrepancy is next to be calculated for each class. The probable limit (P.L.) of the ratios varies with the number (Λ) of ratios found, according to the following table:

Λ_1	P.L.	Λ_1	P.L.	Λ_1	P.L	Λ_1	P.L.
1	1.000	6	2.375	11	2.777	16	3.009
2	1.559	7	2.481	12	2.832	17	3.046
3	1.874	8	2.570	13	2.882	18	3.080
4	2.088	9	2.648	14	2 928	19	3.112
5	2.248	10	2.716	15	2 970	20	3.142

The foregoing method is from Sheppard (1898).

The **probable range** of abscissæ ($2x_l$) of a normal distribution, or that beyond which the theoretical frequency (y) is less than 1, varies with the number of variates (n) as well as with σ, in accordance with the following formula derived by the transposition of $y=\frac{n}{\sigma\sqrt{2\pi}}e^{-x^2/2\sigma^2}$ by putting $y=1$:

$$2x_l=2\sigma\sqrt{\frac{2}{\log e}\log\frac{n}{\sigma\sqrt{2\pi}}}.$$

Example. For the ventricosity of 1000 shells of Littornea littorea from Tenby, Wales, $A=90.964\%$ and $\sigma=2.3775\%$. What is the probable range of ventricosity expressed in per cent.?

$$2x_l=2\times 2.3775\sqrt{.460517\times\log\frac{1000}{2.506628\times 2.3775}}=15.2.$$

The observed range was 15 (Duncker, '98). See also the criterion of Chauvenet ('88) for the rejection of extreme variates (page 12).

The Normal Curve of Frequency as a Binomial Curve.

The normal curve may also be expressed by the binomial formula $(p\times q)^{\Lambda}$, where $p=\frac{1}{2}$, $q=\frac{1}{2}$, and Λ is the number of

terms, less 1, in the expansion of the binomial; hence approximately the number of classes into which the magnitudes of the variates should fall. If the standard deviation be known, A may be found by the equation

$$A = 4 \times (\text{Standard Deviation})^2 = 4\sigma^2.$$

Example of Normal Curve.—Number of rays in lower valve of Pecten opercularis from Firth of Forth:

V	f	$V-V_0$	$f(V-V_0)$	$f(V-V_0)^2$	$f(V-V_0)^3$	$f(V-V_0)^4$
14	1	−3	−3	9	−27	81
15	8	−2	−16	32	−64	128
16	63	−1	−63	63	63	63
17	154	0	0	0	0	0
18	164	1	164	164	164	164
19	96	2	192	384	768	1536
20	20	3	60	180	540	1620
21	2	4	8	32	128	512
	$n=508$		342	864	1446	4104

$\nu_1 = \frac{342}{508} = .6732$; $\nu_2 = \frac{864}{508} = 1.7008$; $\nu_3 = \frac{1446}{508} = 2.8465$; $\nu_4 = \frac{4104}{508} = 8.0787$.

$A = V_0 + \nu_1 = 17 + .6732 = 17.6732.$

$\mu_2 = 1.7008 - 0.6732^2 = 1.2475$; $\sigma = \sqrt{\mu_2} = 1.1169.$

$\mu_3 = 2.8465 - 3 \times 0.6732 \times 1.7008 + 2 \times 0.6732^3 = 0.0217.$

$\mu_4 = 8.0787 - 4 \times 0.6732 \times 2.8465 + 6 \times 0.6732^2 \times 1.7008 - 3 \times 0.6732^4 = 4.4223.$

$\beta_1 = \frac{0.0217^2}{1.1169^3} = 0.0002$; $\beta_2 = \frac{4.4223}{1.1169^2} = 2.8414.$

$F = \frac{0.0002 \times 5.8414^2}{4 \times 11.3650 \times (-0.3178)} = -0.00047$; $F\mu_2{}^3 = 0.0009.$

$\frac{3\nu_2{}^2 - 2\nu_1{}^4}{\nu_4} = \frac{3(1.7008)^2 - 2 \times .7059^4}{8.0787} = 1.011.$

Theoretical maximum frequency, $y_0 = \frac{n}{\sigma\sqrt{2\pi}} = \frac{508}{1.1169\sqrt{2\pi}} = 181.5.$

The probable discrepancy, based on the five larger values of y, is found as follows, the χ_1 values being taken from a table like Table IV:

L	a	χ_1	$A+\sigma\chi_1$	Actual Discrepancy.	Probable Discrepancy.	Ratio of Actual to Probable Discrepancy.
14.5	−0.99606					
15.5	−0.96457	−2.11	15.34	+0.17	.083	2.05
16.5	−0.71654	−1.07	16.51	−0.01	.032	0.31
17.5	−0.11023	−0.138	17.55	−0.05	.025	2.00
18.5	+0.53543	0.73	18.51	−0.01	.027	0.37
19.5	+0.91439	1.72	19.62	−0.12	.054	2.22
20.5	+0.99213					

The extreme values are not calculated for the relations indicated by the formula do not hold well there where the frequencies are small and the proportionate values of y are changing rapidly for small changes of x. For the five values considered the actual discrepancy is less than the probable discrepancy in three cases and less than the probable limit in all.

To find the average difference between the pth and the $(p+1)$th individual in any seriation (Galton's difference problem). Let x_p be the average interval between the pth and $(p+1)$th individual; n the total number of variates; and σ their standard deviation.

Then, (1) when n is large and p small:

$$i_p = \sigma \frac{\sqrt{2\pi p}\quad p^p e^{-p}}{\underline{|p}} \cdot \frac{1}{ny_m}\{1+c_1+c_2+c_3+\ldots\},$$

where $y_m = \dfrac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}m^2}$.

m can be found from Table IV by the use of the formula

$$\frac{n-2p}{n} = \sqrt{\frac{2}{\pi}} \int_0^m e^{-\frac{1}{2}\chi^2} d\chi,$$

where the value of m sought is the argument corresponding to the tabular entry $\left(\dfrac{n-2p}{n}\right)$.

$$c_1 = .83\dot{3}\frac{(n-2p)^2}{n(n-p)p} - 2.5\frac{n-2p}{n^2}\frac{m}{y_m} + 1.875\frac{(n-p)p}{n^3} \cdot \left(\frac{m}{y_m}\right)^2;$$

$$c_2 = -.75\frac{(n-p)^3+p^3}{n^2(n-p)p} + 1.5\frac{n-2p}{n^2}\frac{m}{y_m}$$

$$-.125\frac{(n-p)p}{n^3}\left(7-\frac{4}{m^2}\right)\left(\frac{m}{y_m}\right)^2;$$

$$c_3 = -2.5\frac{(n-p)^5+p^5}{n^3(n-p)^2p^2} + 7.5\frac{(n-p)^4-p^4}{n^4(n-p)p}\cdot\frac{m}{y_m}$$
$$-.625\frac{(n-p)^3+p^3}{n^5}\left(13-\frac{4}{m^2}\right)\left(\frac{m}{y_m}\right)^2$$
$$+.625\frac{(n-2p)(n-p)p}{n^5}\left(6-\frac{7}{m^2}\right)\left(\frac{m}{y_m}\right)^3$$
$$-.02083\left[\frac{(n-p)p^2}{n^3}\right]\frac{31m^4-101m^2+28}{y_m^4}.$$

The solution of the equations for c_1, c_2, and c_3 will be facilitated by finding, once for all, the logarithms of n, $(n-p)$, $(n-2p)$, $(n-p)p$, and $\frac{m}{y_m}$.

(2). When n and p are both large and not nearly equal:

$$i_p = \frac{\sigma}{ny_m}(1+c_1+c_2+c_3+\ \ldots).$$

(3). When n is small the unsimplified form of the equation must be used.

$$i_p = \sigma\frac{\underline{|n}}{\underline{|n-p}\,\underline{|p}}\ \frac{(n-p)^{n-p}p^p}{n^n}\sqrt{2\pi}\ \sqrt{\frac{(n-p)p}{n^3}}$$
$$\times\frac{1}{y_m}(1+c_1+c_2+c_3+\ \ldots).$$

$\underline{|n}$ means the products of all integers from 1 to n. The series c_1, c_2, c_3 is not complete, but the values of c with higher subscripts are so small that they may be neglected.

Let $I_{p'p''}$ be the difference measured in units of σ between the p'th and the p''th individual, then

$$I_{p'p''} = (i_{p'} + i_{p'+1} + i_{p'+2} + \ \ldots\ + i_{p''-1})\sigma.$$

The foregoing method is that of Pearson (1902k) based upon some considerations of Galton (1902).

To find the best fitting normal frequency distribution when only a portion of an empirical distribution is given.

First apply the following parabola of the second order:

(1) $$y=y_0\left\{\varepsilon_0+\varepsilon_1\frac{x}{l}+\varepsilon_2\left(\frac{x}{l}\right)^2\right\},$$

where l is the half range and

$$\varepsilon_0=\tfrac{3}{4}(3\lambda_0-5\lambda_2)=3(\lambda_2-.2\varepsilon_2);$$
$$\varepsilon_1=3\lambda_1;$$
$$\varepsilon_2=3.75(3\lambda_2-\lambda_0);$$

also,

$$y_0=\frac{m_0}{2l};\quad \lambda_0=3\lambda_2-\frac{4}{15}\varepsilon_2;\quad \lambda_1=\frac{m_1}{m_0l};\quad \lambda_2=\frac{m_2}{m_0l^2}.$$

To find m_0 arrange the frequencies in the usual manner (p. 26) and find the logarithm of each; their sum is equal to m_0. Making the class situated at the middle of the range 0, find the deviation of each of the other classes from this class. The algebraic sum of the product of the logarithms by the deviations gives m_1. The second moment about the same zero point gives m_2. Or,

$m_0=\Sigma\log f=\Sigma Y;\quad m_1=\Sigma[Y(V-V_0)];\quad m_2=\Sigma[Y(V-V_0)^2].$

Substituting in (1) we get a numerical quadratic equation which can be put in the form

(2) $$Y=y_0\left\{\varepsilon_2\left[\left(\frac{x}{l}\right)^2+\frac{\varepsilon_1}{\varepsilon_2}\frac{x}{l}+\left(\frac{\varepsilon_1}{2\varepsilon_2}\right)^2\right]+\varepsilon_0-\varepsilon_2\left(\frac{\varepsilon_1}{2\varepsilon_2}\right)^2\right\}$$

$$=y_0\left\{\varepsilon_2\left(\frac{x+\frac{\varepsilon_1 l}{2\varepsilon_2}}{l}\right)^2+\varepsilon_0-\frac{\varepsilon_1^2}{4\varepsilon_2}\right\}.$$

If the normal curve be $y=z_0e^{-\frac{(x+h)^2}{2\sigma^2}}$,

(3) $$Y=\log y=\log z_0-\frac{(x+h)^2}{2\sigma^2}\log e;$$

whence, by comparison of right-hand expressions in equations (2) and (3),

$$\log z_0=y_0\times\left(\varepsilon_0-\frac{\varepsilon_1^2}{4\varepsilon_2}\right);$$

$$2\sigma^2=\frac{l^2\log e}{y_0\times\varepsilon_2}.$$

Then the required normal curve is

$$y=z_0e^{-x^2/2\sigma^2}.$$

(Pearson, 1902m.)

Other Unimodal Frequency Polygons.

The formulas of Pearson's Types I to VI are as follows:

Type I. $y=y_0\left(1+\frac{x}{l_1}\right)^{m_1}\left(1-\frac{x}{l_2}\right)^{m_2}.$

Type II. $y=y_0\left(1-\frac{x^2}{l^2}\right)^{m}.$

Type III. $y=y_0\left(1+\frac{x}{l}\right)^{p}e^{-x/d}.$

Type IV. $y=y_0 \cos \theta^{2m}e^{-\tau\theta}$, where $\tan \theta=\frac{x}{l}.$

Type V. $y=y_0x^{-p}e^{-\gamma/x}.$

Type VI. $y=y_0(x-l)^{q_2}/x^{q_1}.$

In these formulas:

x, abscissæ;

y_0, the ordinate at the origin, to be especially reckoned for each type;

y, the height of the ordinate (or rectangle) located at the distance x from y_0;

l, a part of the abscissa-axis XX' expressed in units of the classes;

e, the base of the Naperian system of logarithms, 2.71828.

The other letters stand for relations that are explained in the sections below treating of each type separately.

The **range of the curve** is limited in both directions in Types I and II, is limited in one direction only in Types III, V, and VI, and is unlimited in both directions in Type IV and the normal curve. The normal curve may give the best fit, however, notwithstanding the fact that in biological statistics the range is ordinarily limited at both extremes. Thus the range of carapace length to total length of the lobster is limited between 0 and 1. The ratio of carapace length to abdominal length in various crustaceans may, however, conceivably take any value from $+\infty$ to 0. In the ratio of dorsoventral to antero-posterior diameter the forms of the molluscan genera Pinna or Malleus on the one hand and Solen on the other approach such extremes.

Asymmetry or **Skewness** (α) is found in Types I, III, IV, V, and VI. In skew curves the mode and the mean are

separated from each other by a certain distance D; or $D=$ mean $-$ mode. Asymmetry is measured by the ratio $\alpha=\frac{D}{\sigma}$. If the mean is greater than the mode, skewness is positive; if the mean is less than the mode, skewness is negative. D, and hence skewness, may be calculated when the theoretical mode is known (see pages 13, 14, and below).

In Types I and III skewness is measured also by the ratio $\alpha=\frac{1}{2}\sqrt{\beta_1}\,\frac{s\pm2}{s\mp2}$, where $s=\frac{6(\beta_2-\beta_1-1)}{3\beta_1-2\beta_2+6}$. When $5\beta_2-6\beta_1-9$ is positive, α has the sign of μ_3; if negative, α has the opposite sign to μ_3 (Duncker, '00[b]).

In Type I, $\alpha=\frac{1}{2}\sqrt{\beta_1}\,\frac{s+2}{s-2}\left(=\frac{1}{2}\sqrt{\beta_1}\,\frac{5\beta^2-6\beta_1-9}{\beta_2+3}\right)$.

" " III, $\alpha=\frac{1}{2}\sqrt{\beta_1}=\frac{\pm\mu_3}{+2\sqrt{\mu_2{}^3}}$, where the sign is the same as that of μ_3.

" " IV, $\alpha=\frac{1}{2}\sqrt{\beta_1}\,\frac{s-2}{s+2}$.

" " V, $\alpha=\frac{2\sqrt{p-3}}{p}$,

since $p-4$ is the positive root of the quadratic:

$$(p-4)^2-\frac{16}{\beta_1}(p-4)-\frac{16}{\beta_1}=0,$$

p is readily found.

In Type VI, $\alpha=\frac{(q_1+q_2)\sqrt{(q_1-q_2-3)}}{(q_1-q_2)\sqrt{\{(q_1-1)(q_2+1)\}}}$,

where $(1-q_1)$ and (q_2+1) are the two roots of the equation

$$z^2-sz+\frac{s^2}{4+\frac{1}{4}\beta_1(s+2)^2/(s+1)}=0.$$

To compare any observed frequency polygon of Type I with its corresponding theoretical curve.

$$y=y_0\left(1+\frac{x}{l_1}\right)^{m_1}\left(1-\frac{x}{l_2}\right)^{m_2}.$$

To find l_1, l_2, m_1, m_2, y_0.

The total **range,** l, of the curve (along the abscissa axis) is found by the equation

$$l=\frac{\sigma}{2}\sqrt{\beta_1(s+2)^2+16(s+1)};$$

l_1 and l_2 are the ranges to the one side and the other of y_0;

$$l_1=\tfrac{1}{2}(l-Ds); \qquad D=\sigma\alpha=\sqrt{\mu_2}\,.\,\alpha;$$

$$l_2=l-l_1;$$

$$m_1=\frac{l_1}{l}(s-2); \qquad m_1+m_2=s-2;$$

$$y_0=\frac{n}{l}\cdot\frac{m_1{}^{m_1}\,.\,m_2{}^{m_2}}{(m_1+m_2)^{m_1+m_2}}\cdot\frac{\Gamma(m_1+m_2+2)}{\Gamma(m_1+1)\Gamma(m_2+1)}.$$

To solve this equation it will be necessary to determine the value of each parenthetical quantity following the Γ sign and find the corresponding value of Γ from Table V. It is, however, sometimes easier to calculate the value of y_0 from the following approximate formula:

$$y_0=\frac{n}{l}\cdot\frac{(m_1+m_2+1)\sqrt{m_1+m_2}}{\sqrt{2\pi m_1m_2}}e^{\frac{1}{12}\left(\frac{1}{m_1+m_2}-\frac{1}{m_1}-\frac{1}{m_2}\right)}.$$

With these data the theoretical curve of Type I may be drawn. Frequency polygons of Type I are often found in biological measurements.

To compare any observed frequency polygon of Type II with its corresponding theoretical curve.

$$y=y_0\left(1-\frac{x^2}{\frac{1}{4}l^2}\right)^m.$$

This equation is only a special form of the equation of Type I in which $l_1=l_2$ and $m_1=m_2$.

As from page 22, $\beta_1=0$ in Type II, $l=2\sigma\sqrt{s+1}$; since the curve is symmetrical, $D=0$, and

$$m=\tfrac{1}{2}(s-2); \quad y_0=\frac{n}{\frac{1}{2}l}\frac{\Gamma(m+1.5)}{\sqrt{\pi}\,\Gamma(m+1)}.$$

The Γ values will be found from Table V.

An approximate formula for y_0 is given by Duncker as follows:

$$y_0=\frac{n}{\sigma\sqrt{2\pi}}\frac{s-1}{\sqrt{(s+1)(s-2)}}e^{-\frac{1}{4(s-2)}}.$$

To compare any observed frequency polygon of Type III with its corresponding theoretical curve.

$$y=y_0\left(1+\frac{x}{l_1}\right)^p e^{-x/d}.$$

The range at one side of the mode is infinite; at the other is found by the formula

$$l_1=\sigma\frac{4-\beta_1}{2\sqrt{\beta_1}}=\sigma\frac{1-\alpha^2}{\alpha}\text{ (for Type III).}$$

Also, $$p=\frac{l_1}{D}=\frac{l_1}{\sigma\alpha};\quad y_0=\frac{n}{l_1}\cdot\frac{p^{p+1}}{e^p\Gamma(p+1)}.$$

The value of Γ corresponding to $p+1$ can be got from Table V, Appendix.

To compare any observed frequency polygon of Type IV with its corresponding theoretical curve.

This is the commonest type of biological skew curves.

$$y=y_0(\cos\theta)^{2m}\cdot e^{-\tau\theta}.$$

θ is a variable, dependent upon x as shown in the equation

$$x=l\tan\theta.$$

The factor $(\cos\theta)^{2m}$ following y_0 indicates that the curve is not calculated from the mean ordinate (A), or the mode ($A-D$), but that the zero ordinate is at $A-mD$; or at a distance $m\times D$ from the mean.

$$l=\frac{\sqrt{\mu_2}}{4}\sqrt{16(s-1)-\beta_1(s-2)^2};\quad m=\tfrac{1}{2}(s+2);$$

$$D=\frac{\sigma}{2}\sqrt{\beta_1}\frac{s-2}{s+2};\qquad mD=\frac{\sigma}{4}\sqrt{\beta}(s-2);$$

$$\tau=\frac{\sqrt{\mu_2}s(s-2)\sqrt{\beta_1}}{4l},\text{ with the opposite sign to }\mu_3;$$

$$\theta \text{ (arc of circle)} = \frac{\pi\theta^\circ}{180^\circ};$$

$$y_0 = \frac{n}{l}\sqrt{\frac{s}{2\pi}}\,\frac{e^{\frac{(\cos\phi)^2}{3s} - \frac{1}{12s} - \tau\phi}}{(\cos\phi)^{s+1}}.*$$

$$\phi = \text{angle whose tangent is } \frac{\tau}{s}.$$

To compare any observed frequency polygon of Type V with its corresponding theoretical curve.

$$y = y_0 x^{-p} e^{-\gamma/x}.$$

To find p solve the quadratic equation

$$(p-4)^2 - \frac{16}{\beta_1}(p-4) - \frac{16}{\beta_1} = 0,$$

and take the positive root.

$$\gamma = \sigma(p-2)\sqrt{p-3}; \quad y_0 = \frac{n \,.\, \gamma^{p-1}}{\Gamma(p-1)}; \quad D = \frac{2\gamma}{p(p-2)}.$$

To compare any observed frequency polygon of Type VI with its corresponding theoretical curve.

$$y = y_0(x-l_1)^{q_2}/x^{q_1}.$$

$1-q_1$ and q_2+1 are the two roots of the equation

$$z^2 - sz + \frac{s^2}{4 + \frac{1}{4}\beta_1(s+2)^2/(s+1)} = 0;$$

$l_1 = s\sqrt{\dfrac{\mu_2(s+1)s^2}{(1-q_1)(1+q_2)}}$, where $(1-q_1)$ and s are negative;

$$y_0 = \frac{n\, l_1^{q_1-q_2-1}\,\Gamma(q_1)}{\Gamma(q_1-q_2-1)\,\Gamma(q_2+1)};$$

$$D = \frac{l(q_1+q_2)}{(q_1-q_2)(q_1-q_2-2)}.$$

---

* The foregoing value is approximate and is applicable when, as is usually the case, s is greater than 2. The exact value is given by Pearson as

$$y_0 = \frac{n}{l} \cdot \frac{e^{\frac{1}{2}\tau\pi}}{\int_0^\pi (\sin\theta)^s e^{\tau\theta}\,d\theta},$$

the formula for reducing which is to be gained from the integral calculus.

Example of calculating the theoretical curve corresponding with observed data. (Fig. 6.)

Distribution of frequency of glands in the right fore leg of 2000 female swine (integral variates):

Number of glands	0	1	2	3	4	5	6	7	8	9	10
Frequency........	15	209	365	482	414	277	134	72	22	8	2

Assume the axis yy' (Vm) to pass through ordinate 4, then:

V	$V-Vm$	f	$f(V-Vm)$	$f(V-Vm)^2$	$f(V-Vm)^3$	$f(V-Vm)^4$
0	−4	15	−60	240	−960	3840
1	−3	209	−627	1881	−5643	16929
2	−2	365	−730	1460	−2920	5840
3	−1	482	−482	482	−482	482
4	0	414	0	0	0	0
5	1	277	277	277	277	277
6	2	134	268	536	1072	2144
7	3	72	216	648	1944	5832
8	4	22	88	352	1408	5632
9	5	8	40	200	1000	5000
10	6	2	12	72	432	2592
	Σ	2000	−998	6148	−3872	48568

$\nu_1 = -998 \div 2000 = -.499.$

$\nu_2 = 6148 \div 2000 = 3.074.$

$\nu_3 = -3872 \div 2000 = -1.936.$

$\nu_4 = 48568 \div 2000 = 24.284.$

$\mu_1 = 0;\ A = 4 - .499 = 3.501.$

$\mu_2 = 3.074 - (-.499)^2 = 2.824999.$

$\mu_3 = -1.936 - 3(-.499 \times 3.074) + 2(-.499)^3 = 2.417278.$

$\mu_4 = 24.284 - 4(-.499 \times -1.936) + 6(.249001 \times 3.074) - 3(-499)^4 = 24.826297.$

$$\beta_1 = \frac{(2.417278)^2}{(2.824999)^3} = \frac{5.843232929}{22.545241683} = 0.259178.$$

$$\beta_2 = \frac{24.826297}{(2.824999)^2} = \frac{24.826297}{7.98061935} = 3.110823.$$

$$F = \frac{.259 \times (6.111)^2}{4(12.443 - .778)(6.222 - 6.778)} = -.373 \quad \therefore \text{ Type I.}$$

$$s = \frac{6(3.11082 - 0.25918 - 1)}{.55589} = 19.9857.$$

$$a = \tfrac{1}{2}\sqrt{.259178}\,\frac{21.9857}{17.9857} = .31115.$$

$$D = 1.680774 \times .3111 = .5230.$$

$$D.s = .5230 \times 19.9857 = 10.4519.$$

$$l = .840387\sqrt{16 \times 20.9857 + 0.25918 \times (21.9857)^2} = 18.0448.$$

$$l_1 = \frac{18.0448 - 10.4519}{2} = 3.7965.$$

$$l_2 = 18.0448 - 3.7965 = 14.2483;$$

$$m_1 = \frac{3.7965 \times 17.9857}{18.0448} = 3.78401;$$

$$m_2 = \frac{14.2483 \times 17.9857}{18.0448} = 14.2006;$$

$$y_0 = \frac{2000}{18.0448} \frac{(18.9846)\sqrt{17.9846}}{\sqrt{2\pi \times 3.7840 \times 14.2006}} \times 2.171828^{.0833(.0556 - .2643 - .0704)}$$

$= 475.24$, the frequency of the *modal* class.

Position of the mode, $y_0 = A - D = 3.501 - .523 = 2.978$. The closeness of fit to the theoretical curve is calculated below by Pearson's method (page 24).

V	f	Theoretical (y)	δ	δ^2	$\frac{\delta^2}{y}$
−1	0	0.0	0.0		
0	15	21.1	− 6.1	37.21	1.76
1	209	185.8	+23.2	538.24	2.90
2	365	395.1	−30.1	906.01	2.30
3	482	475.2	+ 6.8	46.24	.10
4	414	405.6	+ 8.4	70.56	.17
5	277	272.1	+ 4.9	24.01	.09
6	134	147.6	−13.6	184.96	1.25
7	72	65.9	+ 6.1	37.21	.57
8	22	24.1	− 2.1	4.41	.18
9	8	7.0	+ 1.0	1.00	.14
10	2	1.6	+ 0.4	.16	.10
11	0	0.2	− 0.2	.04	
12		0.0			

$$\Sigma \frac{\delta^2}{y} = 9.56$$

$$\Delta = 3.09;\ P = 2.71828^{-\frac{1}{2}(9.56)}\left(1 + \frac{9.56}{2} + \frac{(3.09)^4}{8} + \frac{(3.09)^6}{48} + \frac{(3.09)^8}{384}\right) = .48$$

That is, the probability is that in one out of every two random series belonging to Type I we should expect a fit not essentially closer than that given by our series, which, of course, assures us that this distribution is properly classified under Type I.

The Use of Logarithms in Curve-fitting.

Most of the statistical operations can be greatly facilitated by the use of logarithms. In curve-fitting their use becomes

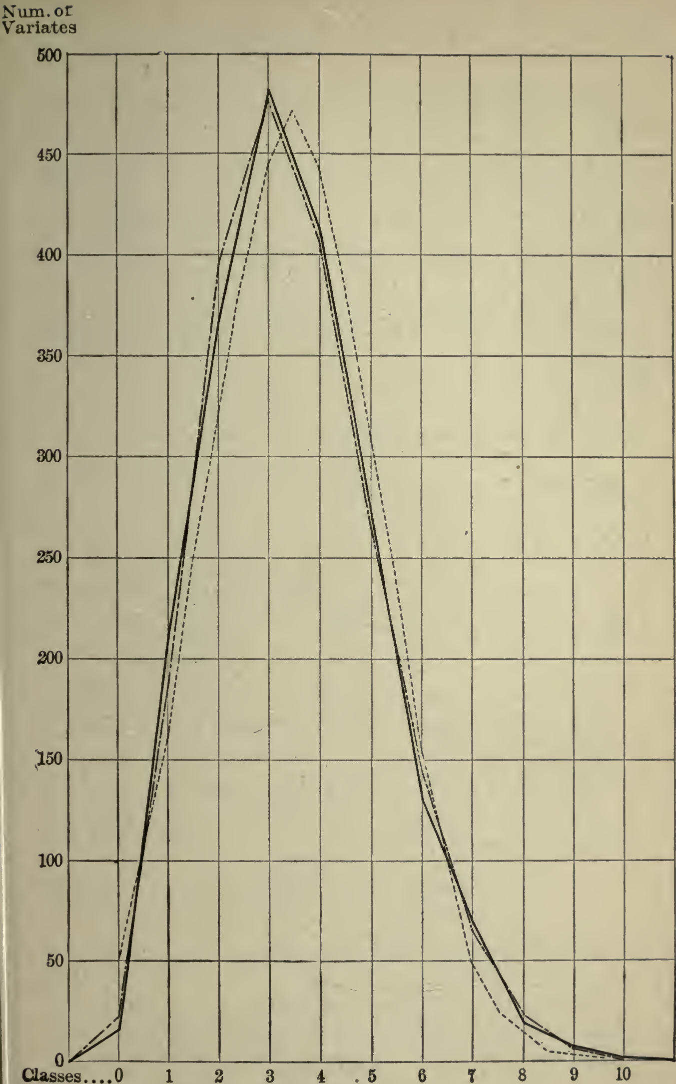

FIG. 6.

Distribution of frequency in glands of swine.

——, polygon of observed frequency.
— · —, polygon of theoretical frequency (Type I).
· · · , normal frequency polygon.

necessary. The following paradigm will be found of assistance:

GENERAL.

$\log \nu_1 = \log \Sigma(V-V_0) - \log n.$ $\qquad A = V_m + \nu_1.$

$\log \nu_2 = \log \Sigma(V-V_0)^2 - \log n.$ $\qquad \log \sigma = \frac{1}{2} \log \mu_2.$

$\log \nu_3 = \log \Sigma(V-V_0)^3 - \log n.$ $\qquad \log C = \frac{1}{2} \log \mu_2 - \log A.$

$\log \nu_4 = \log \Sigma(V-V_0)^4 - \log n.$

$\log \mathrm{E.}_A = 9.828982 + \log \sigma - \frac{1}{2} \log n.$

$\log \mathrm{E.}_\sigma = \log \mathrm{E.}_A - 0.150515.$

$\log \mathrm{E.}_C = \log \mathrm{E.}_\sigma - \log A.$

$\log 2 = 0.301030$	$\frac{1}{12} = .08333$	Find $2 \log \nu_1$
$\log 3 = 0.477121$	$\frac{7}{240} = .02916$	$3 \log \nu_1$
$\log 4 = 0.602060$	$\frac{3}{240} = .0125$	$4 \log \nu_1$
$\log 6 = 0.778151$	$\log \frac{1}{2} = 9.698970$	

$\mu_2 = N(\log \nu_2) - N(2 \log \nu_1) - [.0833].$ Find: $\log \mu_2$; $2 \log \mu_2$; $3 \log \mu_2$.

$\mu_3 = N(\log \nu_3) - N(\log 3 + \log \nu_1 + \log \nu_2) + N(\log 2 + 3 \log \nu_1)$

Find: $\log \mu_3$; $2 \log \mu_3$.

$$\mu_4 = N(\log \nu_4) - N(\log 4 + \log \nu_1 + \log \nu_3) + N(\log 6 + 2 \log \nu_1 + \log \nu_2) - N(\log 3 + 4 \log \nu_1) - N[9.698970 + \log \mu_2] - \tfrac{7}{240}.$$

Find $\log \mu_4$.

$\log \beta_1 = 2 \log \mu_3 - 3 \log \mu_2.$

$\log \beta_2 = \log \mu_4 - 2 \log \mu_2.$

$w = 5\beta_2 - 6\beta_1 - 9$ (Types I, IV).

Skewness:

Type I: $\log \alpha = \frac{1}{2} \log \beta_1 + \log w - \log (\beta_2 + 3) - 0.301030.$

Type III: $\log \alpha = \frac{1}{2} \log \beta_1 - 0.301030.$

Type IV: $\log \alpha = \frac{1}{2} \log \beta_1 + \log (\beta_2 + 3) - \log w - 0.301030.$

Type V: $\log \alpha = \log 2 + \frac{1}{2} \log (p-3) - \log p.$

Type VI: $\log \alpha = \log (q_1 + q_2) + \frac{1}{2} \log (q_1 - q_2 - 3) - \log (q_1 - q_2) - \frac{1}{2} \log (q_1 - 1) - \frac{1}{2} \log (q_2 + 1).$

Type IV.

This is the most difficult of all the types to be fitted. The work of fitting is carried out by the use of logarithms, as follows:

$$\log j = \tfrac{1}{2} \log \beta_1 + \log (s-2). \quad \log k = \log j + \tfrac{1}{2} \log \mu_2.$$

$$\log \alpha = \log j - \log (s+2) - 0.301030.$$

$$\log l = \tfrac{1}{2} \log \mu_2 + \tfrac{1}{2} \log\{N[\log (s-1) + 1.204120] - N[\log \beta_1 + 2 \log(s-2)]\} - 0.602060.$$

$$\log D = \log \alpha + \tfrac{1}{2} \log \mu_2; \quad m = \frac{s+2}{2}.$$

$$\log mD = \log k - 0.602060.$$

$$\log \tau = \log k + \log s - 0.602060 - \log l.$$

$$\log \tan \phi = \log \tau - \log s.$$

$$\log \theta = 8.241877 + \log \theta^\circ.*$$

$$\log y_0 = \log n + \tfrac{1}{2} \log s + N\{\log [N(2 \log \cos \phi - \log 3s) - N(8.920819 - \log s) - N(\log \tau + \log \phi)] + 9.637784\} - 0.399090 - \log l - (s+1) \log \cos \phi.$$

$$\log y = \log y_0 + N [\log (s+2) + \log \log \cos \theta] \mp N[7.8796612 + \log \theta^\circ * + \log \tau].$$

Multimodal Curves.

Multimodal curves are given when the frequency in the different classes exhibits more than one mode. False multimodal curves result from too few observations, or when the classes are too numerous for the variates. By increasing the number of variates or by making the classes more inclusive some of the modes disappear.

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* In degrees and fractions of a degree; see Table VII.

Multimodal curves differ in degree. The modes may be so close that only a single mode (usually in an asymmetrical curve) appears in the result; or one of the modes may appear as a hump on the other; or the two modes may even be far apart and separated by a deep sinus (Figs. 7 to 10).

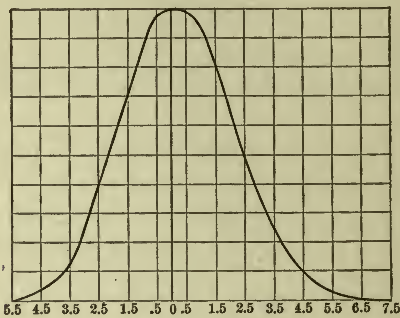

FIG. 7.

Pearson has offered a means of breaking up a compound curve with apparently only one mode into two curves having distinct modes; but this method is very tedious and rarely applicable.

FIG. 8.

The **index of divergence** of two modes of a multimodal curve is the distance between the modes expressed in

terms of the standard deviation of the more variable of the components.*

The **index of isolation** of two masses of variates grouped about adjacent modes is the ratio of the depression between the modes to the height of the shorter mode.

The meaning of multimodal curves is diverse. Sometimes

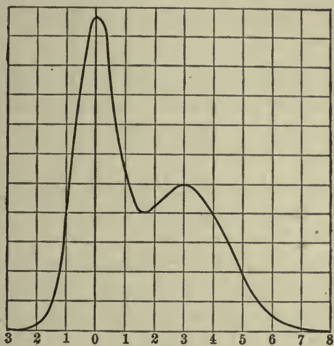

FIG. 9.

they indicate a polymorphic condition of the species, the modes representing the different type forms. This is the case with

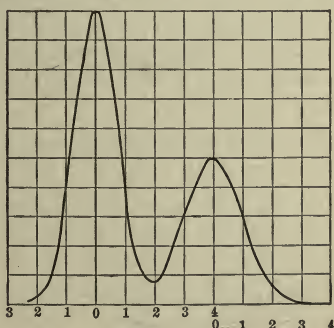

FIG. 10.

the number of ray flowers of the white daisy which has modes at 8, 13, 21, 34, etc. Sometimes they indicate a splitting of a species into two or more varieties.

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* I have proposed (Science, VII, 685) to measure the divergence in a unit = 3 × Standard Deviation, which has certain advantages in species study.

CHAPTER IV.

Correlated Variability.

Correlated variation is such a relation between the magnitudes of two or more characters that any abmodality of the one is accompanied by a corresponding abmodality of the other or others.

The methods of measuring correlation given below are applicable to cases where the distribution of variates is either symmetrical or skew.

The principles upon which the measure of correlated variation rests are these. When we take individuals at random we find that the mean magnitude of any character is equal to the mean magnitude of this character in the whole population. Deviation from the mean of the whole population in any lot of individuals implies a selection. If we select individuals on the basis of one character (A, called the *subject*) we select also any closely correlated character (B, called the *relative*) (*e.g.*, leg-length and stature). If perfectly correlated, the index of abmodality (p. 23) of any class of B will be as great as that of the corresponding class of A, or

$$\frac{\text{Index abmodality of relative class}}{\text{Index abmodality of subject class}} = 1.$$

If there is no correlation, then whatever the value of the index of abmodality of the subject, that of the relative will be zero and the coefficient of correlation will be

$$\frac{\text{Index of abmodality of relative class}}{\text{Index of abmodality of subject class}} = \frac{0}{m} = 0.$$

The coefficient of correlation is represented in formulas by the letter r. We cannot find the degree of correlation between two organs by measuring a single pair only; it is the correlation "in the long run" which we must consider. Hence we must deal with masses and with averages.

Classes of left leg.		0	1	2	3	4	5	6	7	8	9	10				
Deviations of rel. class from mean..........		−3.54	−2.54	−1.54	−0.54	0.46	1.46	2.46	3.46	4.46	5.46	6.46	Means left.	Deviat from M.	$\frac{\text{Dev. Rel.}}{S.\ D._{\text{rel.}}}$	$\frac{\text{Dev.Subj}}{S.D._{\text{subj}}}$
Classes of right leg.	Deviation from mean.															
0	−3.547	8	5	2	......	......	......	......	......	......	......	......	0.600	−2.940	−1.70	−2.05
1	−2.547	4	151	58	9	3	......	......	......	......	......	......	1.360	−2.180	−1.26	−1.47
2	−1.547	2	65	154	96	28	7	1	......	......	......	......	2.306	−1.234	−0.70	−0.90
3	−0.547	......	14	88	173	128	28	6	......	......	......	......	3.197	−0.343	−0.20	−0.32
4	0.453	......	5	27	119	153	77	26	3	1	......	......	3.888	0.348	0.20	0.26
5	1.453	......	1	7	24	92	101	52	11	9	......	......	4.784	1.244	0.72	0.84
6	2.453	......	......	......	8	16	58	48	16	7	0	2	5.510	1.970	1.14	1.42
7	3.453	......	......	......	1	8	20	18	17	9	5	......	6.141	2.601	1.50	2.00
8	4.453	......	......	......	......	1	3	5	3	2	2	......	6.500	2.960	1.71	2.57
9	5.453	......	......	......	......	......	1	3	3	2	2	1	7.333	3.793	2.19	3.15
10	6.453	......	......	......	......	......	......	......	......	......	1	......	9.000	5.460	3.25	3.73

Mean number of glands, right leg, male = 3.547
" " " " left leg, male = 3.540

Standard deviation, relative, 1.73
" " subject, 1.73

In studying correlation one (either one) of the characters is regarded as subject and the other as relative. A correlation table is then arranged as in the example on page 43, which gives data for determining the correlation between the number of Müllerian glands on the right (subject) and left (relative) legs of male swine. The selected subject class is called the *type;* the corresponding distribution of the relative magnitudes is called the *array.*

Methods of Determining Coefficient of Correlation.

Galton's graphic method. On co-ordinate paper draw perpendicular axes X and Y; locate a series of points from the pairs of indices of abmodality of the relative and subject corresponding to each subject class. The indices of the subjects are laid off as abscissæ ; the indices of the relatives as ordinates, regarding signs. Get another set of points by making a second correlation table, regarding character B as subject and character A as relative. Then draw a straight line through these points so as to divide the region occupied by them into halves. The tangent of the angle made by the last line with the horizontal axis XX (any distance yp, divided by xp) is the index of correlation.

A more precise method is given by Pearson as follows:

$$\frac{\text{Sum of products (deviation subj. class} \times \text{deviation each assoc. rel. class} \times \text{no. of cases in both)}}{\text{total no. of indivs.} \times \text{Stand. Dev. of subject} \times \text{Stand. Dev. of relative}};$$

or, expressed in a formula :

$$r = \frac{\Sigma\,(\text{dev. } x \times \text{dev. } y \times f)}{n\sigma_1\sigma_2}.$$

This method requires finding many products in the numerator, as many sets of products as there are entries in the body of the correlation table. A portion of the products to be found in correlation table, p. 43, is indicated below:

$$-3.547 \times \begin{cases} -3.540 \times 8 \\ -2.540 \times 5 \\ -1.540 \times 2 \end{cases}$$

$$-2.547 \times \begin{cases} -3.540 \times 4 \\ -2.540 \times 151 \\ -1.540 \times 58 \end{cases}$$

etc.

The handling of long decimal fractions may be avoided by the use of a method similar to that used at page 26 for finding the average and standard deviation. The formula for r may be written

$$r=\left(\frac{\Sigma(x'y')}{n}-\nu_1'\nu_1''\right)\frac{1}{\sigma_1\sigma_2}.$$

Assuming the class including or nearest to the true mean of the subject values as the mean of the subjects, and the class including or nearest to the true mean of the relative values as the mean of the relatives, find for each variate the product of its deviations x' and y' from the respective assumed means, and (having regard for signs) find the algebraic sum of these products. Divide this sum by the number of variates; the quotient is the average of the deviation products about the assumed axes. To refer to the true axes, passing through the true means, find the average moments, ν_1 (as on page 26), both for the subject and the relative distributions about their respective assumed means, and subtract the product of the two values of ν_1 from the average of the approximate deviation products already found. Divide the difference by the product of the standard deviations of the two frequency distributions. (Compare Yule, '97[b], pp. 12–17.)

The **probable error** of the determination of r is

$$E_r=\frac{0.6745(1-r^2)}{\sqrt{n}}.$$

(Pearson and Filon, '98, p. 242.)

Example. Correlation in number of Müllerian glands on right and left legs of 2000 male swine. (See table on next page.)

For + quadrants $\Sigma(x'y')=5243$

" − " $\Sigma(x'y')=-118$

$$\frac{5125}{2000}=2.5625=\frac{\Sigma(x'y')}{n}.$$

Mean, right leg $=3.5465$. Mean, left leg $=3.5395$. σ_1 right leg $=1.7195$. $\sigma_2=$ left leg $=1.7304$.

Y'	X' Array / Type.	Right leg, type. −4 / 0	−3 / 1	−2 / 2	−1 / 3	0 / 4	1 / 5	2 / 6	Left leg, array. 3 / 7	4 / 8	5 / 9	6 / 0	f	$V-V_0$	$\Sigma y'$	Σy^2
−4	0	$\overset{16}{8}$	$\overset{12}{5}$	$\overset{8}{2}$									15	−4	60	240
−3	1	$\overset{12}{4}$	$\overset{9}{151}$	$\overset{6}{58}$	$\overset{3}{9}$	3							225	−3	675	2025
−2	2	$\overset{8}{2}$	$\overset{6}{65}$	$\overset{4}{154}$	$\overset{2}{96}$	28	$\overset{-2}{7}$	$\overset{-4}{1}$					353	−2	706	1412
−1	3		$\overset{3}{14}$	$\overset{2}{88}$	$\overset{1}{173}$	128	$\overset{-1}{28}$	$\overset{-2}{6}$					437	−1	437 −1878	437
0	4		5	27	119	153	77	26	3	1			411			
1	5		$\overset{-3}{1}$	$\overset{-2}{7}$	$\overset{-1}{24}$	92	$\overset{1}{101}$	$\overset{2}{52}$	$\overset{3}{11}$	$\overset{4}{9}$			297	1	297	297
2	6				$\overset{-2}{8}$	16	$\overset{2}{58}$	$\overset{4}{48}$	$\overset{6}{16}$	$\overset{8}{7}$		$\overset{12}{2}$	155	2	310	620
3	7				$\overset{-3}{1}$	8	$\overset{3}{20}$	$\overset{6}{18}$	$\overset{9}{17}$	$\overset{12}{9}$	$\overset{15}{5}$		78	3	234	702
4	8					1	$\overset{4}{3}$	$\overset{8}{5}$	$\overset{12}{3}$	$\overset{16}{2}$	$\overset{20}{2}$		16	4	64	256
5	9						$\overset{5}{1}$	$\overset{10}{3}$	$\overset{15}{3}$	$\overset{20}{2}$	$\overset{25}{2}$	$\overset{30}{1}$	12	5	60	300
6	10										$\overset{30}{1}$		1	6	6 971 −1878	36 6325 2000
	Σ	14	241	336	430	429	295	159	53	30	10	3				
		−4	−3	−2	−1		1	2	3	4	5	6				
		−56	−723	−672	−430	−1881	295	318	159	120	50	18 | 960				

$$\nu_1''=\frac{960-1881}{2000}=-.4605.$$

$$\nu_1'=\frac{-907}{2000}$$
$$=-.4535$$
$$\nu_2'=3.1625$$
$$\nu_1^2=\ \ .2056$$
$$\mu_2=2.9569$$
$$\sigma_1=1.7195$$

$$r=\left(\frac{\Sigma(x'y')}{n}-\nu_1'\nu_1''\right)\frac{1}{\sigma_1\sigma_2}=(2.5625-.4535\times.4605)$$

$$\times\frac{1}{1.7195\times1.730}=0.7911.$$

$$\mathrm{E.}_r=\frac{.6745[1-(.7919)^2]}{\sqrt{2000}}=\pm.0056.$$

The average variability of an array is $=\sigma\sqrt{1-r^2}$.

The **coefficient of regression** marks the proportional change of the relative organ for a unit's change of the subject organ. It is given by the equation $\rho=r\,\frac{\sigma_1}{\sigma_2}$, where σ_1 is the standard deviation of the subject, σ_2 that of the relative.

The Quantitative Treatment of Characters not Quantitatively Measurable.

Even qualities that do not lend themselves to a quantitative expression may be expressed in a roughly quantitative fashion. The fundamental assumption is made that the frequencies would obey the normal law of frequency more or less closely, provided a quantitative scale could be found. This assumption will not, in most biological data, lead us far astray.

Divide the data into three classes (*e.g.*, in eye-color we may have black, brown and gray, and blue), and let the frequency of these classes be n_1, n_2, n_3, in which n_1 and n_3 are each less than $\frac{1}{2}n$, so that n_2 contains the median. Let L_1, L_3 be the (unknown) distances of the mean from the two boundaries of n_2. Call $L_1/\sigma=h_1$ and $L_3/\sigma=h_3$, then

$$\frac{n_1-n_2-n_3}{n}=\sqrt{\frac{2}{\pi}}\int_0^{h_1}e^{-\frac{1}{2}\chi^2}d\chi$$

and

$$\frac{n_1+n_2-n_3}{n}=\sqrt{\frac{2}{\pi}}\int_0^{h_3}e^{-\frac{1}{2}\chi^2}d\chi.$$

Now the left-hand side in these equations is known; it is $\frac{1}{2}a$ of Table IV. From this table the right-hand value of the

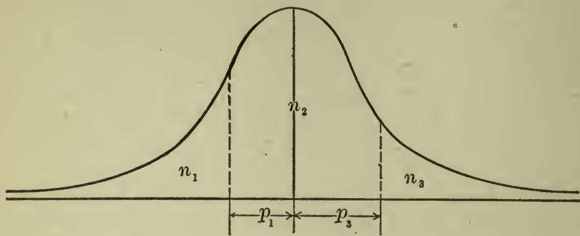

FIG. 11.

equations is found; it is the entry corresponding to the argument $\frac{1}{2}a$. Thus h_1 and h_3 $\left(=\frac{x}{\sigma}\right)$ are found, and hence L_1/σ and L_3/σ and the entire range $\frac{L_3+L_1}{\sigma}$ of the middle class, in terms of σ, is known. Call the range in absolute units l. Then $l=L_3+L_1$ and l/σ is known and for a second series l/σ' can be similarly determined. Hence σ/σ', the ratio of the variabilities of the two series, is determined.

Again, since L_1/σ and $\frac{L_3+L_1}{\sigma}$ are known, $L_1/(L_3+L_1)$ is known, and this gives us the ratio in which the mean divides the true range of the central class. (Pearson and Lee, 1900.)

The foregoing method may sometimes be advantageously employed where the data are quantitative. In this case the numerical value of l is known. (Macdonell, 1902.) Consequently $h_1+h_2=\frac{L_1+L_3}{\sigma}$ is known and hence $\sigma=\frac{L_1+L_3}{h_1+h_3}$, the standard deviation, is found. Since $L_1=h_1\sigma=$ the distance of the mean from the left-hand boundary of n_2, the position of the mean is known.

The probable error of σ is

$$E._\sigma=.67449\frac{L_1+L_3}{(h_1+h_3)^2}\left\{\frac{n_1(n-n_1)}{n^3H_1^2}+\frac{n_3(n-n_3)}{n^3H_3^2}-\frac{2n_1n_3}{n^3H_1H_3}\right\}^{\frac{1}{2}},$$

where $$H_1=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}h_1^2} \quad\text{and}\quad H_3=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}h_3^2}.$$

The values of the last two equations may be obtained directly from Table III.

The probable error of L_1, or of the mean, is

$$\mathrm{E.}_A = .67449 \left\{ \frac{\sigma^2(h_1\Sigma^2_{h_3} + h_3\Sigma^2_{h_1}}{h_1+h_3} - \Sigma^2_{\sigma}h_1h_3 \right\}^{\frac{1}{2}},$$

where $\Sigma^2_{\sigma} = \left(\frac{E\sigma}{.67749}\right)^2, \Sigma^2_{h_1} = \frac{n_1(n-n_1)}{n^3 H_1{}^2}$, and $\Sigma^2_{h_3} = \frac{n_3(n-n_3)}{n^3 H_3{}^2}$.

The Correlation of Non-Quantitative Qualities.

Pearson (1900[c]) has ingeniously discovered a method of expressing correlation quantitatively when the variables cannot be so expressed, as, for example, in the case of effectiveness of vaccination. Strictly, this method assumes normal variation in variables, but it can be employed generally, in default of a better method, with fairly accurate results.

The prime requisite is that the qualities to be compared shall be separable into two grades, an upper and a lower. For example, in the case of the result of vaccination: on the one hand, either presence or absence of a scar; on the other, either recovery or death. As either of the second pair may occur with either of the first pair, four classes, a, b, c, d, will be formed altogether and a correlation surface like the following may be made:

$-y$

$-x$	a	b	$a+b$	x
	c	d	$c+d$	
	$a+c$	$b+d$	n	

y

The axes $y, -y$ and $x, -x$ probably do not coincide with the axes y and x passing through the "origin" of the correlation

surface, but may be regarded as situated from those axes at the respective distances h and k. These values may be found from the formulæ

$$\frac{(a+c)-(b+d)}{n}=\sqrt{\frac{2}{\pi}}\int_0^h e^{-\frac{1}{2}\chi^2}d\chi;$$

$$\frac{(a+b)-(c+d)}{n}=\sqrt{\frac{2}{\pi}}\int_0^k e^{-\frac{1}{2}y^2}dy.$$

a, b, c, and d being known, h and k are found from Table IV. Then

$$H=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}h^2} \quad \text{and} \quad K=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}k^2},$$

of which the values may be looked up in Table III, or, better, their product may be calculated by logarithms as follows:

$$\log HK=9.201820-N\left[\log\frac{h^2+k^2}{2}+9.637784\right].$$

Find also log hk, h^2, and k^2. To find r solve the following equation to as many terms as may be necessary:

$$\frac{ad-bc}{n^2HK}=r+\frac{hk}{2}r^2+\frac{1}{6}(h^2-1)(k^2-1)r^3+\frac{1}{24}hk(h^2-3)(k^2-3)r^4$$

$$+\frac{1}{120}(h^4-6h^2+3)(k^4-6k^2+3)r^5$$

$$+\frac{1}{720}hk(h^4-10h^2+15)(k^4-10k^2+15)r^6+\text{etc.}$$

This gives us a numerical equation of the nth degree which can be solved by ordinary algebraic methods, using Sturm's functions and Horner's method. Or it can be solved by successive approximations as follows: The first approximation is made by neglecting all powers of r above the second and solving the quadratic (remembering, that if $ax^2+bx+c=0$,

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\Big)$, and taking the positive root. Substitute this value in the whole equation to the 4th power for $f(r)$, and in the first derivative of the same equation for $f'(r)$ (remembering that the first derivative of $f(x)$ is obtained by multiplying each term in $f(x)$ by the exponent of x in that term and diminishing the exponent of x by 1). The correction $\frac{f(r)}{f'(r)}$ should be added to the value of r used in substituting. Repeat this process as often as the correction affects the fourth place of decimals, and go to r^5 if necessary.

The probable error of r as thus determined is found as follows: First calculate the relations $\beta_1=\frac{h-rk}{\sqrt{1-r^2}}$ and $\beta_2=\frac{k-rh}{\sqrt{1-r^2}}$. Also find

$$\psi_1=\frac{1}{\sqrt{2\pi}}\int_0^{\beta_1}e^{-\frac{1}{2}\chi^2}d\chi \quad \text{and} \quad \psi_2=\frac{1}{\sqrt{2\pi}}\int_0^{\beta_1}e^{-\frac{1}{2}\chi^2}d\chi$$

from Table IV. Moreover,

$$\omega_0=\frac{1}{2\pi}\,\frac{1}{\sqrt{1-r^2}}e^{-\frac{1}{2(1-r)}(h^2+k^2-2rhk)}.$$

Then,

$$\text{Prob. error of } r=\frac{.67449}{n^{\frac{1}{2}}\sqrt{\omega_0}}[\tfrac{1}{4}(a+d)(c+b)+(a+c)(d+b)\psi_2{}^2$$
$$+(a+b)(d+c)\psi_1{}^2+2(ad-bc)\psi_1\psi_2$$
$$-(ab-cd)\psi_2-(ac-bd)\psi_1]^{\frac{1}{2}},$$

which can be easily solved by substitution. In using the foregoing formula, it must be noted that "a is the quadrant in which the mean falls, so that h and k are both positive." In other words, $a+c>b+d$ and $a+b>c+d$. (Pearson, '00c.)

Example. The eye-colors of a certain set of people (see Biometrika, II, 2 pp. 237–240) and of their great-grandparents were found to be distributed as follows

Offspring.

Great-grandparents.	1 Light Blue.	2 Blue—Dark Blue.	3 Gray—Blue-green.	4 Dark Gray—Hazel.	5 Light Brown.	6 Brown.	7 Dark Brown.	8 Black.	Totals.
1. Light blue	4	3	8	5	....	1	....	....	21
2 Blue—dark blue	8	177	95	76	5	39	31	17	448
3. Gray—blue-green	1	69	85	52	2	20	26	1	256
4. Dark gray—hazel	6	30	21	27	2	7	15	1	109
5. Light brown	....	4	....	....	....	....	....	....	4
6. Brown	2	37	27	17	3	30	20	4	140
7. Dark brown	....	15	20	24	3	4	9	9	84
8. Black	....	10	13	12	2	2	7	5	51
Totals	21	345	269	213	17	103	108	37	1113

It was desired to determine the correlation between the eye-color of the offspring and that of their great-grandparents. Clearly the ranges of the classes given above are not quantitatively equal nor determinable. Consequently a fourfold table was formed by dividing the population into those having eyes whose color was gray blue-green, or lighter, and those having dark gray, hazel, or darker eyes. This gives a good basis for calculation If the dark gray and hazel eyes had been grouped with the lighter eyes it would have made quadrant *a* entirely too large; and there is nothing in the nature of the data that strongly favors one division more than another.

Offspring.

Great-grand-parents.	1–3	4–8	Totals.
1–3	450	275	725
4–8	185	203	388
Totals.	635	478	1113

$$a_1=\frac{725-388}{1113}=.302785$$

$$a_2=\frac{635-478}{1113}=.141060$$

From the tables:

a_1	h
.31	.39886
.30	.38532
.01	.01354

a_2	k
.15	.18912
.14	.17637
.01	.01275

$$h=.38532+(1.354\times.002785)=.389091$$
$$k=.17637+(1.275\times.001060)=.177722$$

$$\begin{array}{lll}
\text{Log } h=9.5900512 & \text{Log } h^2=9.1801024 & h^2=.151392 \\
\text{Log } k=9.2497412 & \text{Log } k^2=8.4994824 & k^2=.031585 \\
\hline
\text{Log } hk=8.8397924 & & h^2+k^2\ .182977 \\
hk=.069150 & \tfrac{1}{2}hk=.034575 & \dfrac{h^2+k^2}{2}=.091489
\end{array}$$

$$\text{Log }(450\times 203-275\times 185)=4.6071869$$

$$\begin{aligned}
\text{Log } HK &= -\log 2\pi - .091489 \log e \\
&= 9.2018201 - N[8.9613689+9.63778428] \\
&= 9.2018201 - 0.0397332 = 9.1620869
\end{aligned}$$

$$\text{Log } \frac{ad-bc}{n^2HK}=4.6071869-(9.1620869+2 \log 1113)=9.3521096$$

$$.224962=r+.034755r^2+\tfrac{1}{6}(h^2-1)(k^2-1)r^3+\tfrac{1}{24}hk(h^2-3)(k^2-3)r^4+\text{etc.}$$

Solving $.034575r^2+r-.224962 \doteq 0$,

$$r=\frac{1\pm\sqrt{1+4(.034575\times .224962)}}{2(.034575)}=.223225 \text{ to 1st approx.}$$

$$h^2-1=-.848608 \qquad k^2-1=-.968415 \qquad \text{Coeff. } r^3=.136967$$

$$\text{Coeff. } r^4=\frac{+.069150\times 2.848608\times 2.968415}{24}=.024363.$$

$$.024363r^4+.136967r^3+.034575r^2+r-.224962=0.$$

Applying Newton's approximation, we reach the result

$$r=.2217.$$

$$\text{E.}_r=\frac{.67449}{n^{\frac{3}{2}}\omega_0}(75095+303530\psi_2^2+281300\psi_1^2+80950\psi_1\psi_2 -86195\psi_2-27425\psi_1)^{\frac{1}{2}}$$

$$\text{Log } \omega_0=\log \tfrac{1}{2}\pi-\tfrac{1}{2}\log(1-r^2)-N[\log\log \epsilon+\log(h^2+k^2-2rhk) -\log(1-r^2)-\log 2]$$

$$h^2+k^2-2rhk=0.152315, \qquad 1-r^2=0.950850.$$

$$\begin{aligned}
\text{Log } \omega_0 &= 9.20182-9.989056-N[9.637784+9.18274-9.978112-0.30103] \\
&= 9.1779797
\end{aligned}$$

$$\text{Log } \frac{.67449}{n^{\frac{3}{2}}\omega_0}=9.828975-4.569743-9.177980=4.081253.$$

$$\beta_1=0.358614 \qquad \beta_2=0.093794$$

From Table IV:

β_1	ψ_1	β_2	ψ_2
.358	.13983	.093	.03705
	22.2		27.3
	.4		3.5
	ψ_1 = .14006		ψ_2 = .03736

$$\text{Log E.}_r=\bar{4}.0812530+\tfrac{1}{2}\log 74426.858$$

$$\text{E.}_r=0.03289$$

Quick Methods of Roughly Determining the Coefficient of Correlation.

The method just described may be used in lieu of the relation $r=\frac{\Sigma x_1 y_1}{n\sigma_1\sigma_2}$ whenever the distributions of frequencies of the two correlated organs are normal. An exceedingly simple relation that is independent of the assumption of a normal distribution has been given by Yule ('00[b]) as

$$r_2=\frac{ad-bc}{ad+bc},$$

and this may be used as a rough approximation to the coefficient of correlation.

But Pearson ('00[c]) has shown that this simple relation is not nearly as close to the true r as the following:

$$r_3=\sin\frac{\pi}{2}\frac{1}{\sqrt{1+k_2}},$$

where

$$k_2=\frac{4abcd\,.\,n^2}{(ad-bc)^2(a+d)(b+c)}.$$

The superiority of the value r_3 as an approximation to r justifies the additional work its determination demands.

Spurious Correlation in Indices.

When two characters a and b are measured in each individual of a series of individuals, and each absolute magnitude is transformed into an index by dividing it by the magnitude of a third character c as found in the same individuals, a spurious correlation will be found to exist between the indices of $\frac{a}{c}$ and $\frac{b}{c}$ (Pearson, '97).

Let C_1 = the coefficient of variability of a;
C_2 = " " " " " b;
C_3 = " " " " " c;
r_0 = " " " spurious correlation.

$$r_0=\frac{C_3^2}{\sqrt{C_1^2+C_3^2}\sqrt{C_2^2+C_3^2}}.$$

The precise method of using r_0 in modifying any determination of r is uncertain. Pearson recommends using $r - r_0$ as the true measure of "organic correlation" in the case of indices.

Heredity.

Heredity is a certain degree of correlation between the abmodality of parent and offspring. The statistical laws of heredity deal not with relations between one descendant and its parent or parents, but only with mean progeny of parents. Any group of selected parents is called a parentage, the progeny of a parentage is called a fraternity.

Three categories of inheritance have long been recognized (Galton, 1888, p. 12). These are: (1) *blending* heritage illustrated by stature in man; (2) *alternative* heritage, illustrated by human eye-color; and (3) *mixed* heritage, illustrated by the piebald condition of the progeny of mice of different colors. The immediately following statistical laws of inheritance hold especially for blending heritage.

In **uniparental inheritance,** as in budding or asexual generation, heredity of any character is measured by the coefficient of correlation between the abmodality in a parentage and the abmodality of the corresponding fraternity. More strictly, since the variability of the character in the second generation, σ_2, may (as a result of selection or of environmental change) be different from the variability of the character in the first generation, σ_1, the index should be taken as $r\frac{\sigma_1}{\sigma_2}$, called the coefficient of regression.

The **probable error of this determination** is $\frac{.6745\sigma_1}{\sigma_2}\sqrt{\frac{1-r_{12}^2}{n}}$, in which r_{12} means the correlation coefficient between the filial character and that of the single parent under consideration.

The variability of the fraternity is to variability of offspring in general as $\sqrt{1-r^2}$ is to 1.

In **biparental inheritance,** if there is no evidence of assortative mating, or correlation between the two parents in the character in question, the mean abmodality of any frater-

nity will be

$$h_1 = r_3\frac{\sigma_1}{\sigma_2}h_2 + r_2\frac{\sigma_1}{\sigma_3}h_3,$$

where h_1 = average abmodality of fraternity;

h_2 = average abmodality of male parent;

h_3 = average abmodality of female parent;

r_2 = correlation coefficient between fraternity and female parent;

r_3 = correlation coefficient between fraternity and male parent;

σ_1 = standard deviation of fraternity;

σ_2 = standard deviation of male parent;

σ_3 = standard deviation of female parent.

When assortative mating occurs, *as is usually the case*, the abmodality of a fraternity is given by

$$h_1 = \frac{r_3 - r_1 r_2}{1 - r_1^2} \cdot \frac{\sigma_1}{\sigma_2} h_2 + \frac{r_2 - r_1 r_3}{1 - r_1^2} \cdot \frac{\sigma_1}{\sigma_2} \cdot h_3,$$

where r_1 = correlation between male and female parents. The other letters have the same signification as before.

The strength of heredity in assortative mating is measured by the formula

$$\frac{r_3 - r_1 r_2}{1 - r_1^2} \cdot \frac{\sigma_1}{\sigma_2}.$$

To find the coefficient of correlation between brethren from the means of the arrays.

This is given by the formula

$$r = \frac{\Sigma[\tfrac{1}{2}n_1(n_1 - 1)A_1]/n - A_2^2}{\sigma^2},$$

where n_1 is the number of the brethren in an array [and therefore $\frac{1}{2}n_1(n_1-1)$ is the number of possible pairs of brothers in that array]; A_1 is the mean value of the array; σ is the standard deviation of the character in the brethren taken all together, n is the total number of variates, and A_2 is the average of the brethren. This method will be found useful where to take all possible pairs of brethren would be found a work of too great magnitude (Pearson, Lee, etc.,'99, p. 271).

Galton ('97) has shown that an individual inherits not only from his parents, but also from his grandparents, great-grandparents, and so on. The heritage from his 2 parents together is, on the average, 50% or $\frac{1}{2}$ of the whole; from the 4 grandparents 25% or $\frac{1}{4}$; from the 8 great-grandparents 12.5% or $\frac{1}{8}$; from the nth ancestral generation $\frac{1}{2^n}$ of the whole; the total heritage adding up 100%. This law has been generalized by Pearson ('98) as follows:

$$h_1 = \frac{1}{2}\frac{\sigma_0}{\sigma_1}k_1 + \frac{1}{4}\frac{\sigma_0}{\sigma_2}k_2 + \frac{1}{8}\frac{\sigma_0}{\sigma_3}k_3 + \frac{1}{16}\frac{\sigma_0}{\sigma_4}k_4 + \dots ,$$

where h_1 = average abmodality of fraternity.

σ_0 = standard deviation of fraternity.

$\sigma_1, \sigma_2 \dots \sigma_s$ = standard deviation of mid-parent of 1st, 2d ... sth ancestral generation.

k_1 = abmodality of mid-parent of 1st ancestral generation.

$k_2, k_3 \dots k_s$ = abmodality of mid-parent of 2d, 3d ... sth ancestral generation.

The abmodality of the mid-parent of any degree of ancestry may be taken as the average abmodality of all the contributory ancestors of that generation.

Mendel's Law of Alternative Inheritance.

In 1865 Gregor Mendel published an account of his experiments in Plant Hybridization and reached the following laws, which have been abundantly confirmed in certain experiments.

First Case. The two parents differ in one character (the antagonistic peculiarity)—case of monohybrids.

Of the two antagonistic peculiarities the cross exhibits only one; and it exhibits it completely, so as not to be distinguishable in this regard from one of the parents. Intermediate conditions do not occur [in *alternative* heritage].

2. In the formation of the pollen and the egg-cell the two antagonistic peculiarities are segregated; so that each ripe germ-cell carries only one of these peculiarities.

Of the two antagonistic peculiarities united in the cross, that which becomes visible in the soma is called by Mendel the *dominating*, that which lies latent is called the *recessive* character. What determines which character shall be dominating is still unknown, and the determination of this point offers an enticing field of inquiry. In some cases the dominating form is the systematically *higher*, in others it is the older or ancestral form.

The law of dichotomy may now be developed. When a mongrel (monohybrid) fertilization takes place the zygote contains both the dominant quality (abbreviated d) and the recessive quality (r). In the early cleavages d and r are both passed over into both the daughter-cells; but apparently, at the time of segregation of the germ-cells, the somatic cells are provided with d only, while the germ-cells retain both qualities. In the ripening of these germ-cells, probably in the reduction division, d and r come to reside in distinct cells, so that we have

of the female cells $50\% d + 50\% r$, and
of the male cells $50\% d + 50\% r$.

If now mongrels are crossed haphazard, a male d cell may unite with either a female d cell or with a female r cell; likewise a male r cell may unite with a female d or a female r cell. Consequently in the long run we shall have of all the zygotes

$$25\% d,\ d + 50\% d,\ r + 25\% r,\ r,$$

or 50% of the zygotes hybrid and 50% of pure blood, and of the latter half exclusively maternal and half paternal. But since the soma developed from the hybrid germ-cell has the dominant character, we shall have

75% of the cases with the dominant character;
25% " " " " recessive "

and this agrees with various empirical results, of which the following from Correns is instructive. A cross was obtained between a variety of pea with a green (g) germ and one having a yellow (y) germ. Yellow is dominating.

Gen. 1.	31 y (hybrid) peas produced 12 plants; these bore:			
Gen. 2.	775 y (hybrid $+y$) peas (=75.8%) 21 plants were produced:			247 g (pure-blooded) peas (=24.2%).
	7 (33%) pure-blooded y, because they bore:	14 (66%) hybrids, because they bore:		20 plants bore:
Gen. 3.	292 y peas	462 y (hybrid $+y$) peas (=76.4%)	149 g (pure-blooded) peas (=23.6%)	670 green peas.

It is clear that if this process of crossing of the hybrids continues, the *proportion* of hybrids to the whole population will diminish; for the share of pure-blooded forms breeds true; while the originally equal share of hybrids is repeatedly halved.

If the hybrid is crossed with one of the parents instead of with another hybrid, we will get

$$(1)\quad (d+r)d=d,\ d+d,\ r, \qquad \text{and}$$
$$(2)\quad (d+r)r=d,\ r+r,\ r.$$

In (1) all of the progeny will appear of the dominant type. In (2) one-half will appear of that type. This again agrees with experiment.

Second Case. The two parents differ in respect to *two* characters—case of dihybrids. Imagine a lot of ripe germ-cells with the antagonistic qualities of any pair separated according to the second principle stated at the outset. A indicates the one pair of qualities and B the other; then we shall have nine classes of zygotes, the proportion of each of which is as follows:

$$A. \qquad \overbrace{25\%\,d,\ d}$$
$$B. \quad 6.25\%\,d,\ d;\ 12.5\%\,d,\ r;\ 6.25\%\,r,\ r.$$
$$A. \qquad \overbrace{50\%\,d,\ r}$$
$$B. \quad 12.5\%\,d,\ d;\ 25\%\,d,\ r;\ 12.5\%\,r,\ r.$$
$$A. \qquad \overbrace{25\%\,r,\ r}$$
$$B. \quad 6.25\%\,d,\ d;\ 12.5\%\,d,\ r;\ 6.25\%\,r,\ r.$$

Thus the first class has 6.25% purely dominant in both characters; the second class, 12.5% purely dominant in one character and hybrid in the other, and so on. Recalling that hybrid zygotes produce somas with the dominant character, it follows that the progeny appear as follows:

		Ratios
A. dom. + B. rec.	18.75%	3
A. rec. + B. dom.	18.75%	3
A. dom. + B. dom.	56.25%	9
A. rec. + B. rec.	6.25%	1

This result again agrees with experiment. The resulting mixture of characters in tri- to polyhybrids may be likewise predicted, by extending the principles already laid down.

Measure of Dissymmetry in Organisms.

A Dissymmetry-Index, Ξ, measuring the average degree of asymmetry in the right and left organs of bilateral organisms, has been proposed by Duncker (1903).

First a series of integral differences -3, -2, -1, 0, 1, 2, 3, 4, etc., between the right- and left-side measurements of the organ in question is made, and the frequencies of each integral difference (reckoning to the nearest integer) is found. The average of the difference series is the difference of the averages of the right- and left-side measurements, and the standard deviation of the difference is given by

$$\sigma_d = \sqrt{\sigma_{\mathrm{I}}^2 + \sigma_{\mathrm{II}}^2 - 2r\sigma_{\mathrm{I}}\sigma_{\mathrm{II}}},$$

in which the subscripts refer to the bilateral series of which the asymmetry is to be found, and r is the coefficient of correlation between the two sides.

Let d' represent any positive differences in the series, and d'' any negative differences; and let f_1', f_2', etc., represent the frequencies of the negative-difference classes, and f_1'', f_2'', etc., the frequencies of the positive-difference classes. Then the asymmetry-index

$$\Xi = \frac{\Sigma(f') \times \Sigma(d') - \Sigma(f'') \times \Sigma(d'')}{n[\Sigma(d') + \Sigma(d'')]} = 0.$$

Example. Absolute difference between dextral (d) and sinistral (s) lateral edges (L) of carapace of right-handed fiddler-crabs—Gelasimus pugilator (Yerkes, 1901; Duncker, 1903):

$d=L_d-L_s$:	-1	0	1	2	3
f:	1	63	310	23	3

$$\Sigma(d')=310\times1+23\times2+3\times3=365, \quad \Sigma(f')=336.$$
$$\Sigma(d'')=1, \quad \Sigma(f'')=1, \quad n=400.$$

$$\Xi=\frac{336\times365-1\times1}{400\times366}=\frac{122639}{146400}=0.83770.$$

CHAPTER V.

Some Results of Statistical Biological Study.

It is hoped that the following analysis of the literature, although not complete, will prove suggestive and otherwise useful. Numerical results are occasionally given. These are intended to be used in making comparisons with numerical results obtained in the same field and thus to assist in the interpretation of such results. The literature references are to the Bibliography which follows this chapter, in which the titles are arranged by author and date.

GENERAL.

Expositions, Addresses, etc.: Amann, '96; Ammon, '99; Camerano, '00[b], '01, '02; Davenport, '00, '00[d], 01[b]; Duncker, '99[b]; Eigenmann, '96; Galton, '01; Gallardo, '00, '01, '01[b]; Ludwig, '00, '03; Redeke, '00; Volterre, '01.

Text-books: Galton, '89; Bateson, '94; Duncker, '00; Pearson, '00; Vernon, '03.

Method: Camerano, '00; Engberg, '03; Fechner, '97; Galton, '89, '02; Heincke, '97; Johannsen, '03; Pearson, '94, '95, '96, '97, '97[b], '98, '00[c], '01[d], '02[c], '02[f], '02[g], '02[m], '02[n], '03[e]; Pearson and Lee, '00; Sheppard, '98, '98[b], '03; Verschaffelt, '95; Wasteels, '99, '00; Yule, '97, '97[b], '00, '00[b], '03.

VARIABILITY.

General.

Frequency polygon, its significance; its dependence on time, place, and conditions: Burkill, '95; Kellerman, '01; Tower, '02; Shull, '02; Yule, '02; Johannsen, '03.

Proper value of ratio of first to second prizes: Galton, '02; Pearson, '02[k].

Coefficient of variability; significance: Pearson, '96; Brewster, '97; Duncker, '00[b]; Davenport, '00[e].

Mutations: Bateson, '94; Howe, '98; deVries, '01–'03; Weldon, '02[c].

Individual vs. specific variation: Brewster, '97, '99; Field, '98; Mayer, '02; Davenport '03[b].

Variability independent of sexual reproduction: Warren, '99, '02; Pearson and others, '01[c], pp. 359–362.

Relative variability of the sexes:—in man, Pearson, '97[c]; Brewster, '99; Pearl, '03; in crabs, Schuster, '03.

Relative variability of primitive and modern races:—in man, primitive races less variable: Pearson, '96, p. 281; Pearson (and others), '01[c], p. 362.

Man.

Stature.—Seriation for adults of different races: Bavarians, Ammon, '99; United States, recruits, Baxter, '75, Pearson, '95, p. 385; various, Macdonell, '02; English middle upper classes, Galton, '89, Pearson, '96, p. 270; Germans, Pearson, '96, p. 278; French, Pearson, '96, p. 281; Cambridge University students, Pearson, '99.

Lot.	n	A	σ	C
Engl. upper middle class ♂	683	69.215″ ± .066	2.592″ ± .047	
do. husbands .	200	69.135″ ± .126	2.628″ ± .089	3.66
Cambridge Univ. students		68.863″ ± .054	2 522″ ± .048	
		cm.	cm.	
English fathers..........	1078	171.95	6.81	3.99
English sons.	1078	174.40	6.94	3.98
U. S. recruits	25878	170.94	6.56	3.84
N. S. Wales, criminals....	2862	169.88	6.58	3.80
Frenchmen	284	166.80	6.47	3.88
English criminals........	3000	166.46	6.45	3.88
French, Lyons	.....	166.26 ± .53	5.50 ± .37	
Germans...............	390	156.93	6.68	4.02
		in.	in.	
Engl. upper middle class ♀	652	64.043 ± .061	2.325 ± .043	
do. wives....	200	63.869 ± .110	2.303 ± .078	
Cambridge Un. students ♀		63.883 ± .130	2.361 ± .092	3.69
French, Lyons ♀		154.02 cm. ± .52	5.45 ± .37	

Seriation at different ages: British infant at birth, Pearson, '99; school children, Bowditch, '91; St. Louis schoolgirls, Porter, '94, Pearson, '95, p. 386; Australian adult whites, Powys, '01.

Lot.	Average.	σ	C
New-born infant, British ♂.	20.503 ± .028 in.	1.332 ± .020	6.500
" " " ♀.	20.124 ± .025 "	1.117 ± .018	5.849
St. Louis schoolgirls.......	118.271 cm.	2.776	

Australian whites:

Age, Years	Average. ♂	Average. ♀	σ ♂	σ ♀	C ♂	C ♀
20–25	66.95	62.50	2.475	2.365	3.70	3.79
25–30	67.30	62.76	2.562	2.432	3.81	3.87
30–40	67.15	62.44	2.587	2.303	3.86	3.69
40–50	66.91	62.96	2.618	2.555	3.91	4.06
50–60	66.74	62.22	2.633	2.591	3.95	4.16
60 & over	66.26	61.31	2.682	2.300	4.04	3.75

Weight.—Seriations at different ages, British: Infants, Pearson, '99; University students, Pearson, '99; 5552 Englishmen, Sheppard, '98.

Lot.	Average.	σ	C
New-born infants, ♂	7.301 ± .024 lb.	1.144 ± .017	15.66%
" " ♀	7.073 ± .021	1.006 ± .015	14.23
Cambridge Univ. students, ♂	152.783 ± .35	16.547 ± .25	10.83
" " " ♀	125.605 ± .77	14.030 ± .57	11.17

Skull.—Cephalic index: Bavarians, Ranke, '83; 6800 20-year old Badeners, working class, Ammon, '99, p. 85; various races, Pearson, '96, p. 2?0, Macdonell, '02.

Lot.	n	A	σ	C
Bavarian peasants	100	83.41	3.58	4.29
Baden recruits	6748	81.15	3.63	4.48
Modern Parisians	....	79.82	3.79	4.74
French peasants	56	79.79	3.84	4.81
Cambridge students	1000	78.33	2.90	3.70
Criminals (British)	100	76.86	3.65	4.75
Brahmans of Bengal	100	75.77	3.37	4.44
Whitechapel English...............	107	74.73	3.31	4.43
Maquada race	....	72.94	2.98	3.95

Skull capacity: coefficients of variability. Fawcett and Lee, '02.

Lot.	♂	♀	Lot.	♂	♀
Andamanese........	5.04	5.59	Naquadas	7.72	6.92
Ainos	6.89	6.82	Germans	7.74	8.19
Negroes............	7.07	6.90	Egyptian mummies..	8.13	8.29
Low-caste Punjabs ..	7.24	8.99	Polynesians	8.20	5.55
Parisian French	7.36	7.10	Italians	8.34	8.99
Kanakas	7.37	6.68	Modern Egyptians...	8.59	7.17
17th Century English.	7.68	8.15	Etruscans	9.58	8.54

Various cranial dimensions, Lee and Pearson, '01.

Other Organs.—Coefficient of variability of bones of skeleton of French and Naquada (*C*. of limb-bones, 4.53–5.57), Warren, '97; appendicular skeleton, Pearson, '96; finger-bones, Lewenz and Whiteley, '02; seriation of position of spinal nerves, Bardeen and Elting, '01; various organs in diverse races, Brewster, '97, '99.

Mammalia.

Relative variability of specific and generic characters in various mammals the former being greater, Brewster, '97; seriation of number of Müllerian glands in Sus scrofa, n, 2000; A, $3.501 \pm .025$; σ, $1.680 \pm .018$; C, 48.0, Davenport and Bullard, '96.

Aves.

Seriations of various proportions of N. A. birds, Allen, '71; characters of Lanius ("shrike") and its races, Strong, '01;

Lot.	n	A	σ	C
Shrike, length L. wing ♂	168	99.06 mm.	2.74 mm.	2.81
" " " ♀	112	97.98	2.64	2.69
" tail length ♂	141	101.57	3.48	3.43
" " " ♀	95	99 55	3.63	3.65
" bill length, ♂	164	12.01	0.71	5.89
" " " ♀	112	11.71	0.63	5.35
" " depth, ♂	126	9.27	0.42	4.57
" " " ♀	85	8.95	0.41	4.61
" melanism of crown, ♂	144	83.57%	3.0%	3.58
" " " " ♀	99	83.66	3.19	3.81
" " upper tail-coverts ♂	142	53.13	15.42	29.02
" " " " " ♀	104	47.98	18.99	39.58
Curvature of culmen	...	29.94°	2.74°	9.15

Eggs, proportions: Passer domesticus, Bumpus, '97, Pearson, '02[e]; various species, Latter, '02.

Species.	Av. Length, Bird, in.	n	Length, mm. A	σ	C	Breadth, mm. A	σ	C
Cuckoo	14	243	22.40	1.059	4.72	16.54	.650	3.93
Blackbird	10	114	29.44	1.357	4.61	21.73	.787	3.62
Song-thrush	9	151	27.44	0.999	3.64	20.69	.516	2.50
Starling	8–8.5	27	29.78	1.097	3.68	21.76	.423	1.94
Yellowhammer	7	32	21.55	0.682	3.17	16.04	.405	2 53
Tree-pipit	6.5	27	20.01	0.698	3.49	15.09	.449	2.97
Meadow-pipet	6	74	19.72	1.250	6.37	14.56	.561	3.84
House-sparrow (English)	6	687	21.82	1.195	5.47	15.51	.525	3.38
House-sparrow (American)	6	868	21.32	1.05	4.92	15.34		
Hedge-sparrow	6	26	20.12	0.810	4.02	14.73	.415	2.81
Robin	6	57	20.22	0.857	4.24	15.43	.477	3.09
Linnet	5.5–6	65	17.14	0.598	3.49	13.33	.358	2.69

Amphibia.

Seriations of variations in position of pelvic girdle in Necturus, Bumpus, '97.

Pisces.

Geographical races: in Leuciscus, Eigenmann, '95; in adjacent lakes, Moenkhaus, '96; in schools of herring, Heincke, '97; in flounders, Bumpus, '98; in mackerel, Williamson, '00. See under Local Races.

Various species: Pimephales fin-rays and scales of lateral line, Voris, '99; Zeus faber, an ancestral Pleuronectid, has its plates symmetrical in only 23.6% of the individuals, Byrne, '02; dimensions of 141 Petromyzon, Lönnberg, '93.

Tracheata.

Lepidoptera.—Seriations of wing dimensions of Thyreus abbotti, Field, '98; number of "eye-spots" on wing of Epinephele, Bachmetjew, '03; number of spots on different species of the genus Papilio, Mayer, '02; breadth of wing, 98♂ Strenia clathrata $C=4.57$, Warren, '02.

Aphidæ.—Asexually produced offspring show an average variability of 60% that of the race, Warren, '02, p. 144; seriation of fertility, empirical mode = 7 young, Warren, '02, p. 133; reduced variability of the earlier generations, because they include only such as can produce fertile offspring, Warren, '02.

Dimension.	Grandmothers.		Children.	
	σ	C	σ	C
Frontal breadth	2.28 mm.	6.07%	2.96 mm.	8.26
Length R. antenna	7.36	8.77	10.94	12.97
Ratio: $\frac{\text{Length antenna}}{\text{Frontal breadth}}\times 10$	1.23%	5.67	1.84	7.82

Myriapoda.—Lithobius: seriations of length of adults, C, for ♂'s = 10.97; ♀'s = 11.25; number of prosternal teeth; of antennal joints; of coxal pores in which C varies from 9.9 to 15.4, Williams, '03.

Crustacea.

Podophthalmata.—Seriations of 12 dimensions of right-handed and left-handed "fiddler-crabs," Gelasimus pugilator, C varies from 7.0 to 11.1, Yerkes, '01; relative variability of male and female Eupagurus prideauxi from deep and from shallow water, Schuster, '03; forehead breadths of Carcinus

mœnas, Weldon, '93, Pearson, '94; various dimensions, Crangon, Weldon, '90; length of rostrum, Palæmon serratus, Thompson, '94, Pearson, '94; number of rostral teeth of Palæmonetes, Weldon, '92[b], Pearson, '95, Duncker, '00.

Lot.	A, mm.	σ, mm.	C, %
Eupagurus, short edge of R. chela:			
♂ deep water	$9.708 \pm .085$	2.76	28.5
♂ shallow water	$10.272 \pm .075$	2.59	25.2
♀ deep water	$7.400 \pm .033$	1.06	14.3
♀ shallow water	$7.485 \pm .029$	1.02	13.6
Eupagurus, long edge of R. chela:			
♂ deep water	$17.97 \pm .14$	4.73	27.8
♂ shallow water	$18.68 + .13$	4.38	23.5
♀ deep water	$14.14 \pm .06$	1.67	11.9
♀ shallow water	$13.97 \pm .05$	1.82	13.0
Eupagurus, carapace length:			
♂ deep water	$8.59 \pm .05$	1.67	19.4
♂ shallow water	$7.54 \pm .03$	0.94	12.5
♀ deep water	$7.12 \pm .03$	0.86	12.1
Palæmonetes vulgaris, dorsal spines	8.28	0.81	9.83
" " ventral spines	2.98	0.45	15.03
Palæmonetes, varians, dorsal spines	4.31	0.86	20.00
" " ventral spines	1.70	0.48	28.26

Amphipoda.—Seriations of lengths of body, of second antennæ, and of ratio of second antennæ to body-length, Smallwood, '03.

Annelida.

Chætopoda.—Teeth on jaws of Nereis virens. Right: $A = 10.055 \pm .045$, $\sigma = 1.339 \pm .032$, $C = 13.3\%$; Left: $A = 10.00 \pm .044$, $\sigma = 1.306 \pm .031$, $C = 13.1\%$, Hefferan, '00.

Brachiopoda.

Seriation of width ÷ breadth, width of sinus ÷ depth, number of plications on ventral and dorsal valves in sinus and on fold, Cummings and Mauck, '02.

Bryozoa.

Number of spines on statoblasts of Pectinatella magnifica. $A = 13.782 \pm .031$, $\sigma = 1.318 \pm .022$, $C = 9.57 \pm .16$, Davenport, '00[e].

Mollusca.

Gastropoda.—Frequency polygons of ventricosity, weight, and index of Littorina littorea for 3 British and 10 American localities—greater variability in America. Index: $\sigma_B = 2.3\%$,

$\sigma_A = 2.7\%$, $C_B = 2.6\%$, $C_A = 3.0\%$, Bumpus, '98, Duncker, '98; critical, Bigelow and Rathbun, '03; seriations of length, ratio of diameter to length, ratio of aperture to length, apical angle, number of whorls, color of aperture lip, and depth of suture between whorls in Nassa, Dimon, '02; seriations of shell-index and spinosity of Io in different parts of a river system, Adams, '00; variability of adult Clausilia laminata less than that of young, 15:13, ascribed to periodic selection, although average size not altered, Weldon, '01; variability of bands of Helix nemoralis in one spot of America, Howe, '98; in different localities near Strasburg, Hensgen, '02.

Lamellibranchiata.—Seriation of number of ribs of Cardium, Baker, '03; Pecten; ray-frequency, Lutz, '00, Davenport, '00, '03, '03[b]; change in proportions with age, acquisition of new symmetry about transverse axis; definition of form units from different localities, Davenport, '03, '03[b].

Lot.	Number of Rays.		
Pecten irradians:	A	σ	C
Cold Spring Har., L. I., R. valve	$17.353 \pm .018$	$0.876 \pm .013$	$5.05 \pm .07$
Cutchogue, L. I., R. valve	$16.534 \pm .034$	$0.852 \pm .024$	$5.32 \pm .36$
Cold Spring Har., L. valve ...	$16.790 \pm .022$	$0.916 \pm .015$	$5.46 \pm .09$
Cutchogue, L. valve	$15.954 \pm .105$	$0.881 \pm .075$	$5.52 \pm .49$
Pecten opercularis:			
Eddystone, R. valve	$17.478 \pm .029$	$1.000 \pm .020$	$5.72 \pm .12$
Irish Sea, R. valve	$18.101 \pm .029$	$1.074 \pm .021$	$5.93 \pm .11$
Firth of Forth, R. valve	$17.673 \pm .027$	$1.117 \pm .019$	$6.32 \pm .11$
Pecten gibbus:			
Tampa, Fla., R valve	$20.512 \pm .030$	$0.991 \pm .021$	$4.83 \pm .10$
Pecten ventricosus:			
San Diego, Cal., R. valve	$19.495 \pm .087$	$0.885 \pm .019$	$4.55 \pm .10$

Echinodermata.

Seriation of ray-frequency in starfish, Crossaster papposus: $A = 12.391$, $C = 0.788$, $v = 6.36\%$, Ludwig, '98[b].

Coelenterata.

Scyphomedusæ.—Seriation of number of tentaculocysts of Aurelia aurita: $n = 3000$, empirical range 4–15; empirical mode $= 8$, genital sacs, $M' = 4$, range, 2–10, Browne, '95, '01.

Hydromedusæ.—Seriation of number of radial canals, gonads, gastric lobes, and tentacles of Gonionemus, Hargitt, '01; radial canals and lips of Pseudoclytia pentata, Mayer, '01, Davenport, '02; radial canals, etc., of Eucope, Agassiz and Woodworth, '96.

Lot.	A	σ	C
Pseudocyltia, num. radial canals	5.004 ± .094	0.441	8.81
" lips	4.868 ± .012	0.556	11.4

Protista.

Paramecium recently divided, Simpson, '02; seriation of diameter of Actinospherium and number of cysts and nuclei in body, Smith, '03; outer and inner diameters of shell of 502 Arcella vulgaris, Pearl and Dunbar, '03; various diatoms, Schröter and Vogler, '01.

Lot.	A	σ	C
Paramecium, length μ.	229.05	19.15	8.36%
" breadth.......	68.13	9.16	13.44
" index	29.91	4.03	
Arcella, outer diameter......	55.79 ± .17	5.73 ± .12	10.27 ± .22
" inner diameter	15.91 ± .07	2.17 ± .05	13.66 ± .30

Plants.

General.—Multimodal polygons especially frequent in plants, Ludwig, '97; critical, Lee, '02; Pearson, '02[h].

Ray-flowers in Compositæ.—Seriation of ray-frequency of Coreopsis, de Vries, '94; of Senecio nemorensis, S. fuchsii, Centurea cyanus, C. jacea, Solidago virga aurea, Achilla millefolium, Ludwig, '96; ray-frequency in Chrysanthemum, Ludwig, '97[c], Lucas, '98, Tower, '02, Pearson and Yule, '02; Helianthus, Wilcox, '02; Bellis perennis, Ludwig, '98[b]; Solidago serotina, Ludwig, '00[b]; Arnica montana, Ludwig, '01; Aster, Shull, '02.

Num. Ray-flowers.	A	σ	C
Aster shortii	14.000 ± .068	1.526 ± .048	10.90
A. novæ-angliæ	42.874 ± .302	6.308 ± .213	14.71
A. punicens................	36.672 ± .107	4.480 ± .076	12.22
A. prenanthoides	28.080 ± .107	4.070 ± .077	14.52

Other Seriations of Floral Organs: *Ranunculaceæ.*—Petals, Ranunculus bulbosus, de Vries, '94, Pearson, '95; calyx, coralla, stamens, and pistils of Ficaria verna, Ludwig, '01; number of Ficaria pistils, early flowers, $A = 17.448$, $\sigma = 3.89$; late flowers, $A = 12.147$, $\sigma = 3.88$; number of stamens, early, $A = 26.731$, $\sigma = 3.761$ and late, $A = 17.863$, $\sigma = 3.298$,

MacLeod, '99, Weldon, '01; number of petals of Caltha palustris, de Vries, '94; number of calyx parts and petals of Trollius europæus and number of fruits per head of Ranunculus acris, Ludwig, '98b, '00b; number of seeds per capsule-compartment of Helleborus fœtidus, Ludwig, '97.

Cruciferæ.—Number of flowers, Cardamine pratensis, empirical modes at 2, 5, 8, 11, 13, 16, 19, 22, not in Fibonacci series, Vogler, '03.

Papaveraceæ.—Number of floral organs in Papaver, MacLeod, '00; number of sepals and petals in the lesser Celandine, various species, Pearson and others, '03.

Caryophyllaceæ.—Number of stamens in Stellaria media, varies with season and position on plant, Burkill, '95; number of anthers in 44,542 flowers of Stellaria media—a complex polygon due to effect of age and environment, Reinöhl, '03.

Sapidaceæ.—Number of compartments in fruit of Acer pseudoplatanus, de Vries, '94.

Leguminosæ.—Number of blossoms in clover plants, Type I: $\sigma = 2.788$, de Vries, '94, Pearson, '95, p. 402; number of elevated flowers in blossoms of Trifolium repens perumbellatum, de Vries, '94; floral organs of Lotus uliginosus, L. corniculatus, Medicago saliva, M. falcata, Ludwig, '97; flowers per head of Lathyrus, Ludwig, '00b.

Rosaceæ.—Number of stamens of Prunus spinosa and Cratægus, Ludwig, '01; sepals of 1000 Potentilla tormentilla and petals of 4097 Potentilla anserina, de Vries, '94.

Cornaceæ.—Number of flowers in head of Cornus mas and C. sanguinea, not in Fibonacci series, Vogler, '03.

Caprifoliaceæ.—Number of petals of 1167 Weigelea amabilis, de Vries, '94: number of flowers in inflorescence and number of petals on flower of Adoxa moschatellina, Whitehead, '02.

Dipsacæ.—Number of flowers per head in Knautia arvensis, maximum at 64, Vogler, '03.

Compositæ.—Number of male and female flowers in umbel of Homogyne, Ludwig, '01.

Primulaceæ.—Number of flowers per umbel, Primula, multimodal, Ludwig, '97, '98b, '00; rays in Primula farinosa, Vogler, '01.

Scrophulariaceæ.—Number of parts in peloria of Lenaria spuria, Yost, '99; number of stamens, Digitalis, Gallardo, '00.

Orchidaceæ.—Extremes in variability of number of spots on flower, Chodat, '01.

LEAVES.—Seriation of numbers of paired leaflets of Pirus aucuparia, Fraxinus excelsior, Senecio nemorencis, and Polemonium, Ludwig, '97, '98[b]. Length and breadth of leaves of Fagus silvatica and Carpinus betulus, Ludwig, '99. Leaf-dimensions, Sanguinaria, Liriodendron, Ampelopsis, and Ailanthis (n, small), Harshberger, '01. Number of side ribs on leaves of Fagus silvatica, Carpinus betulus, and Quercus monticola, Ludwig, '99; on leaves of beech, Pearson, '00; leaves of mulberry, Fry, '02; dimensions of Typha leaves, Davenport and Blankinship, '98; pine needles. Ludwig, '01; from various branches of Pinus silvestris, Lee, '02.

Lot, length of pine needles	A mm.	σ mm.	C
Pinus silv., lower branches. .	$22.163 \pm .048$	$4.474 \pm .034$	20.19
" " middle branches.	$26.524 \pm .055$	$5.167 \pm .039$	19.48
" " upper branches .	$25.949 \pm .062$	$5.858 \pm .044$	22.59

Fruit.—Number of ears in head of Agropyrum repens and Brachypodium, Ludwig, '01; of the grass Lolium, Ludwig, '00[b]; fruits per head of Ranunculus acris Ludwig, '00[b]; number of seeds per capsule-compartment, Helleborus, Ludwig, '97; fruit length, Oenothera Lamarckiana, and Helianthus, de Vries, '94; dimensions of beans in masses and in successive generations of same family, Johannsen, '03.

BRYOPHYTA.—Seriations of length of capsule-stalk, Bryum cirratum, Amann, '96; parts in sexual organs of Marchantea and Lonicera, Ludwig, '00[b].

SOME TYPES OF BIOLOGICAL DISTRIBUTIONS.

General.—Pearson, '95 '01[d]. α modified by selection, Reinöhl, '03.

Type I.

Petals of 222 flowers of Ranunculus bulbosus, de Vries, '94, Pearson, '95, p. 401.

Number of glands of fore legs of swine, Davenport and Bullard, '96, Pearson, '96, p. 291: $\alpha = .311 \pm .016$.

Fertility (percentage of births with one year of marriage) of wives at different ages, Powys, '01.

Rays in dorsal fin of Pleuronectes ♂, Duncker, '00.

" " anal " " " ♀, " "

Type IV.

Stature of St. Louis schoolgirls, Pearson, '95, p. 386. $\alpha = -0.489$.

Number of teeth, Palæmonetes varians Plymouth, Pearson, '95, p. 404. $\alpha = 0.134$.

Stature of Australian whites, Powys, '01.

Rays in dorsal fin of Pleuronectes, ♀, Duncker, '00.

" " anal " " " ♂ " "

" " pectoral " " " ♂ " "

Type V.

Number of lips of medusa, P. pentata, Mayer, '01, Pearson, '01[d]. $\alpha = .549$.

Normal.

Stature, U. S. recruits, Baxter, 75, Pearson, 95, p. 385.

Ray frequency, Pectens, Davenport, '00, '03[b].

Skewness.

General.—*Mathematical Analysis.*—Pearson, '95, '01[d], '02[f], '02[g], '02[m]. *Biological Interpretation.*—Davenport, '01[b], '01[c].

Quantitative Results.

Numerous cranial characters, Naquada race, Fawcett, '02.	Nearly always +.
Num. lips of medusa, P. pentata (Mayer, '01; Pearson, '01[d])	+.549
Num. Müllerian glands, legs of swine (Pearson and Filon, '98)	+.311
Num. dorsal teeth, Palæmonetes varians (Pearson, '95)	+.130
Num. rays, Pecten opercularis, Irish Sea (Davenport, '03[b])	+.087
" " " " Eddystone (Davenport, '03[b])	+.080
" hooks on statoblasts, Pectinatella (Davenport, '00[e])	+.077
Weldon's crab measurements, "No. 4" (Pearson, '95)	+.077
Num. rays lower valve, Pecten irradians, L. I (Davenport, '00[c])	+.023
" " " " P. opercularis, F. of Forth	+.007
" " upper valve, P. irradians (Davenport, '00[c])	±.000
Height, British criminals (Macdonell, '02)	−.023
Baxter's height of U. S. recruits (Pearson, '95)	−.038
Porter's height of 2192 St. Louis schoolgirls (Pearson, '95)	−.049
Head breadth, British criminals (Macdonell, '02)	−.051

Index of Littorina, Casco Bay (Bumpus, '98)	+.13
Index of Littorina, Newport (Bumpus, '98)	+.25
" " " Humber " "	+.048
" " " So. Kincardineshire (Bumpus, '98)	+.068
21-rayed Chrysanthemum (de Vries, '99)	−.13
13- " " " " "	+.12
Selected 12- (and 13-) rayed Chrysanthemum (de Vries, '99)	+1.9
Rays of Pecten irradians, fossil, Va oldest (Davenport, '01[b])	−.22
" " " " " " youngest	−.16
" " " " recent, N C	−.09
" " " " recent, L. I.	+.023
Length of wings of long-winged chinch-bug (Davenport, '01[b])	−.43
" " " " short-winged chinch-bug " "	+.44
Length horns rhinoceros-beetle, long-horned (Davenport, '01[b])	−.03
" " " " short-horned " "	+.48

Complex Distributions.

Bimodal Polygons.—Discontinuity in hairiness of Biscutella, Saunders, '97; of Lychnis, Bateson and Saunders, '02, Weldon, '02[c].

Length of cephalic horns of rhinoceros-beetle, and forceps length of male earwigs, Bateson, '94; explanation of dimorphism, Giard, '94.

Multimodal Polygons.—Modes fall in Fibonacci series, Ludwig, '96, '96[b], '96[c], '97, '97[b], '97[c]

Modes of Chrysanthemum segetum at 13, 21, de Vries,'95.

Opposed to Fibonacci series, complex polygon due to lack of homogeneity, Lucas, '93, Shull, '02, Pearson, '02[h], Lee, '02, Reinöhl, '03, Vogler, '03.

CORRELATION.

General and Method.—Galton, '88, '89, Pearson, '96, Yule, '97, '97[b]; spurious correlation, Pearson,'97; non-quantitative characters, Pearson, '00[c], Pearson and Lee, '00, Yule, '00, '00[b], '02; index not constant in related races, Weldon, '92, Pearson, '96, '98[b] p. 175, '02[n] p. 2, Davenport, '03[b].

Man.

General.—Galton, '88; British criminals, various dimensions, $r=.13$ to .84, Macdonell, '02.

Skull.—Correlated with cranial capacity in living persons, Lee and Pearson, '01; breadth and length, Naquada, Bavarians, French, Pearson, '96, p. 280; N. A. Indians, Boas, '99;

various dimensions, Aino and German, Lee and Pearson, '01; Naquadas, Fawcett and Lee, '02. With civilization woman's correlation tends to gain on man's, Lee and Pearson, '01, Pearson, '02[n].

Lot.	r
Breadth and Length:	
German, ♀	.49 ± .05
Smith Sound Eskimo	.47
Aino, ♂	.43 ± .06
Aino, ♀	.37 ± .07
German, ♂	.29 ± .06
Modern Bavarian peasants	.28 ± .06
Naquada race	.27
Sioux Indians	.24
Modern French peasants	.13 ± .09
British Columbian Indians ♂	.08
Modern French (Parisians)	.05 ± .06
Shuswap Indians	.04

Lot.	r ♂	r ♀
Aino:		
Capacity and length	.89 ± .01	.66 ± .05
" " breadth	.56 ± .05	.50 ± .07
" " height	.54 ± .05	.52 ± .07
Length and height	.50 ± .05	.35 ± .07
Breadth and height	.35 ± .06	.18 ± .08
Cap. and ceph. index	− .31 ± .07	− .25 ± .09
German:		
Capacity and breadth	.67 ± .04	.70 ± .03
" " length	.51 ± .05	.69 ± .04
" " height	.24 ± .06	.45 ± .05
Cap. and ceph. index	.20 ± .06	− .03 ± .07
Breadth and height	.07 ± .06	.28 ± .06
Length and height	− .10 ± .07	.31 ± .06

Skeletal.—Rollet, '89; stature correlated with length of long bones, reconstruction of stature of extinct races, Pearson, '98[b]; various coefficients of correlation, Pearson, '99, '00, p. 402; in hand-bones, Whiteley and Pearson, '99, Lewenz and Whiteley, '02.

Lot.	r
Right and left femur	.96
Metacarpals, ii and iii digits right	.94
First joints, iv digit, R. and L. hands	.93
First joints, ii and iii, right	.90
Metacarpals, ii and v digits, right	.89
Femur and humerus	.84 to .87
Femur and tibia	.81 to .89
First joints, ii and v, right	.82
Stature and femur	.80(♀) to .81(♂)
Stature and humerus	.77(♀) to .81(♂)
Stature and tibia	.78(♂) to .80(♀)
Humerus and ulna	.75 to .86
Humerus and radius	.74 to .84
Radius and stature	.67 (♀) to 70(♂)
Clavicle and humerus	.44 to .63
Forearm and stature	.37
Clavicle and scapula	.12 to .16
Stature and cephalic index	−.08

Various: Pearson, '99; intelligence not correlated with size or shape of head, Pearson, '02.

Weight and length of new-born infant ♂	.644 ± .012
" " " " " " " ♀	.622 ± .013
Weight and stature of Cambridge (Engl.) students, ♂	.486 ± .016
" " " " " " " ♀	.721 ± .026
Breadth of head (reduced to 12th yr.) and intelligence, youth	.084 ± .024
Length of head (reduced to 12th yr.) and intelligence, youth	.044 ± .024
Cephalic index and intelligence, youth	.005 ± .024
Breadth of head and ability, adults	.045 ± .032
Cephalic index and ability, University men	.031 ± .035
" " " length of head, University men	−.086 ± .033

Vaccination and *Recovery.*—Pearson, '00[c]; Macdonell, '02, '03. $r = .23$ to .91.

Assortative Mating.—Pearson, '96, '99[b], '00, Pearson and Lee, '00.

Stature of husbands and wives	$r = .093 \pm .047$
ditto, another determination	$r = .28 \pm .02$
Eye-color, husbands and wives	$r = .100 \pm .038$
Age at death of consorts	$r = .22$

Lower Animals.

ANTIMERICALLY SYMMETRICAL ORGANS:

Paired organs.—Number of Müllerian glands on R. and L. fore legs of swine, Davenport and Bullard, '96; R. and L. fins of fishes, Duncker, '97, '00; number of coxal pores on R. and L. legs of the centipede Lithobius, Williams, '03; R. and L. dimensions of Gelasimus, Yerkes, '01, Duncker, '03; number of teeth on R. and L. jaws of Nereis, Hefferan, '00; breadth of R. and L. valves of Pecten, Davenport, '03b; skeletal spicules on R. and L. half of Echinus larva.

Subject and Relative.	*r*
Length R. and L. sides of carapace, Gelasimus	.947 ± .003
" " " " meropodite, first walking leg	.918 ± .005
Breadth R. and L. valve of Pecten opercularis, Irish Sea	.858 ± .006
Num. of teeth R. and L. jaws of Nereis	.820 ± .008
" " fin-rays R. and L. pectoral, Acerina	.710
" coxal pores R. and L. 14th pair legs, Lithobius	.69 ± .02
" " " " " " 13th pair legs, Lithobius	.686 ± .029
" " " " " " 12th pair legs, Lithobius	.58 ± .04
" " " " " " anal pair legs, Lithobius	.575 ± .039

Other antimeric organs:

	r
Num. of dorsal and ventral spines, Palæmonetes vulgaris (Duncker, '00b)	.380 ± .019
Num. of lips and canals of the medusa, Pseudoclytia (Mayer, '01; Davenport, '02)	.325 ± .019

SECONDARILY ANTIMERIC ORGANS.—(Median organs in animals that lie on one side.)

	r
Num. of dorsal and anal fin-rays in flounder, ♂	.651
" " " " " " " " ♀	.690
Length antero-posterior and dorso-ventral diameters, Pecten	.970 ± .001

Unsymmetrical paired organs.—Pleuronectes, Duncker, '00; Gelasimus, the fiddler-crab, Yerkes, '01, Duncker, '03.

Length of meropodite, R. and L. chelæ of Galasimus	.754 ± .014
" " carpopodite, R. and L. chelæ of Gelasimus	.698 ± .017
" " propodite, R. and L. chelæ of Gelasimus	.473 ± .026
Num. rays R. and L. pectoral fin, flounder, Pleuronectes, ♂	.594
" " " " " " " " " ♀	.582
" of dorsal fin-rays at which lateral line ends, R. and L. Pleuronectes, ♂	.467
Num. rays R. and L. ventral fin, Pleuronectes, ♂	.243

METAMERICALLY REPEATED ORGANS.—Fin-rays of fishes, Duncker, '97; coxal pores centipede, Williams, '03; segments of shrimp Crangon, Weldon, '92.

Num. dorsal spines and soft fin-rays, Acerina	−.379
" " " " " " " Cottus	.11C
" coxal pores R. anal and 14th segment, Lithobius	.440
" " " R. 13th and 14th segments, Lithobius	.722
" " " R. 13th and 12th segments, Lithobius	.464
Length carapace and post-spinous portion rostrum, Crangon....	.81
" " " tergum VI abd. seg., Crangon............	.09
" tergum VI and telson, Crangon......................	−.11

MIXED AND CROSS CORRELATION.—Length of wing and tail of Lanius "shrike," Strong, '01; in fishes, Duncker, '97, '99; proportions of aphids, "plant-lice," Warren, '02; coxal pores of centipede, Williams, '03; length of carapace and of chelæ in Eupagurus, "hermit-crab," Schuster, '02; diameter of cell and body length, Daphnia, Warren, '03; cross correlation in teeth on jaws of Nereis, Hefferan, '00; various characters of the mud-snail, Nassa, Dimon, '02; circumference to number of spines, statoblast of Bryozoa, Davenport, '00[e]; diameter of body of the Heliozoan Actinosphærium Echorni and the number of cysts and of nuclei, Smith, '03; inner and outer diameters and color of the shell of Arcella, Pearl and Dunbar, '03.

Organs.	*r*
Carapace length and chela length, Eupagurus, ♂	.9389 ± .0036
" " " " " " ♀	.8626 ± .0080
Diameter of body of Actinospherian and num. of nuclei	.854 ± .017
Inner and outer diameter shell of Arcella............	.836 ± .007
Diam. of body of Actinosphærium and num. of cysts..	.769 ± .026
Wing length and tail length, Lanius	.569
Diam. of cell and body length, Daphnia, hatching to 3d molt	.551
Diam. of cell and body length, Daphnia, 3d to 4th molt	.393
Diam. of cell and body length, Daphnia, after 4th molt..	.248
Num. coxal pores, R. anal and L. 12th seg., Lithobius...	.427 ± .046
Frontal breadth and antennal length (Warren, '02)....	.320 ± .032
Coxal pores, R. 14th leg and body length, Lithobius...	.308 ± .059
Num. rays dorsal fin and end-point of L. lateral line, Pleuronectes, ♂	.208
Outer diameter and color Arcella	.012
Num. dorsal spines and L. pectoral rays, Pleuronectes.	.004

Organs.	r
Body length and number antennal joints	$-.013 \pm .067$
Circumference of statoblast and number spines, Pectinatella	$-.092 \pm .006$
Num. R. definite teeth and L. indefinite, Nereis	$-.524 \pm .023$
Carapace length and chela index, Eupagurus	$-.522 \pm .022$
Num. of cysts and their diam., Actinosphærium	$-.669 \pm .040$

Plants.

Between various parts of flowers, Ludwig, '01.

Floral parts.—Stamens and pistils of Ficaria, MacLeod, '98, '99, Ludwig, '01, Weldon, '01, Lee, '02; rays and bracts and rays and disc florets of Aster, Shull, '02; various organs on Lesser Celandine, Pearson and others, '03.

Organs.	r
Num. rays and bracts. Aster	.856 to .799
" stamens and pistils Ficaria ranunculoides, early	$.507 \pm .031$
" " " " " " late	$.749 \pm .015$
" rays and disc florets, Aster	.574 to .353
" petals and sepals Ficaria verna	+.34 to −.18
" stamens and pistils, Celandine	.43 to .75
" " " petals, Celandine	.38 to .22
" pistils and petals, Celandine	.35 to .19
" " " sepals, Celandine	.25 to .03
" stamens and sepals, Celandine	.06 to .02

Other parts.—Size of leaves of same rosette of Bellis perennis, Verschaffelt, '99; various pairs of dimensions of fruits and leaves, Harshberger, '01; parts of Syndesmon, Kellerman, '01.

HEREDITY.

General.

Treatises.—Galton, '89, Pearson, '00.

Classification.—Galton, '89, pp. 7, 12, Pearson and Lee, '00, pp. 89, 91, 98.

Law of ancestral heredity.—Galton, '97, Pearson, '98; estimate of heredity from a *single* ancestral generation, Pearson, '96, p. 306.

Inequality in parental transmission.—Father prepotent in sons; mother in daughters, Pearson and Lee, '00, p. 115; heredity weakened by change of sex, Pearson and Lee, '00, p. 115, Lutz, '03.

Inheritance of Eye-color, Homo. s, son; d, daughter; f, father; m, mother.	No. of Changes of Sex.			
	0	1	2	3
Parental { Average of r_{sf} and r_{dm}	.530			
Parental { " " r_{sm} and r_{df}	.....	.459		
Grand-parental { " " r_{sff} and r_{dmm}	.370			
Grand-parental { " " r_{sfm}, r_{dff}, r_{dmf}, r_{smm}	.....	.300		
Grand-parental { " " r_{smf}, r_{dfm}	.....	.....	.296	
Great-grand-parental inheritance, average	.347	.222	.145	.038

Parental.

Exceptional fathers produce exceptional sons at a rate three to six times that of non-exceptional fathers and exceptional pairs at ten times the rate of non-exceptional pairs, Pearson, '00[c], pp. 38, 47.

x y	Cor. r	Reg. ρ_{xy}
Longevity:		
Father and son (Beeton and Pearson, '99)	.12	
" " adult son (Beeton and Pearson, '01)	.135	.10
" " adult dau. " " " "	.130	.08
Mother and adult son " " " "	.131	.12
" " " dau. " " " "	.149	.12
Eye-color (Pearson and Lee, '00)	.55 to .44	
Stature, English middle class:		
Father and son (Pearson, '96, p. 270)	.396	.352
" " dau. " " "	.360	.419
Mother and son " " "	.302	.269
" " dau. " " "	.284	.275
Head index, N. Amer. Indian:		
Mother and son (Pearson, '00, p. 458)	.370	
" " dau. " " "	.300	
Coat-color, thoroughbred horses:		
Sire, foal (Pearson, '00, p. 458)	.517	
Dam, foal " " "	.527	
Fertility:		
Mother and daughter, British upper class	.042 ± .010	
Father and son, " " "	.051 ± .009	
Mother and daughter, British peerage	.210	
Father and son, " "	.066	
Mother and daughter, landed gentry	.105	
Father and son " "	.116	
	r	ρ
Frontal breadth, Hyalopterus (Warren, '02)	.335	.359
Length R. antenna, Hyalopterus " "	.427	.507
Ratio: R. antenna ÷ frontal breadth (Warren, '02)	.439	.539
Ratio: Length protopodite ÷ length body, Daphnia (Warren, '02)	.466	.619

Grandparental.

	r	ρ
Coat color, thoroughbred race-horses	.339	
" " Basset hounds	.113	
Frontal breadth, Hyalopterus, Aphidæ (Warren, '02)	.321	.269
Length, R. antenna, Aphidæ (Warren, '02)	.177	.192
Ratio R. antenna ÷ frontal breadth, Aphidæ (Warren, '02)	.231	.295
Ratio Length protopodite ÷ length body, Daphnia (Warren, '02)	[.27	.5]
Stature.		
Gr'dson and gr'df., homo male line (Pearson, '96)		.199
" " " " female line (Pearson, '96)		.089
Grtgr'dson and grtgr'df. homo ♂ line " "		.105
" " " " ♀ " " "		.031

Eye-color,	homo, f.,	grandfather, and	son	(Blanchard,	'03)	.421
Coat "	horse, "	"	" "	"	"	.324
Eye "	homo, "	"	" dau.	"	"	.380
Coat "	horse, "	"	" "	"	"	.360
Eye "	homo, m.,	"	" son	"	"	.372
Coat "	horse, "	"	" "	"	"	.359
Eye "	homo, "	"	" dau.	"	"	.297
Coat "	horse, "	"	" "	"	"	.311
Eye "	homo, f.,	grandmother, and	son	"	"	.272
Coat "	horse, "	"	" "	"	"	.309
Eye "	homo, "	"	" dau.	"	"	.221
Coat "	horse, "	"	" "	"	"	.204
Eye "	homo, m.,	"	" son	"	"	.262
Coat "	horse, "	"	" "	"	"	.261
Eye "	homo, "	"	" dau.	"	"	.318
Coat "	horse, "	"	" "	"	"	.239

Fraternal.

	r
Daphnia, length of spine (Warren, '99; Pearson, '01[c])	.693
Aphis, antennal length (Warren, '02).........................	.679
" frontal breadth (Warren, '02).........................	.666
Paramecium, index of just separated fission pairs (Simpson, '02).	.664
Horse, coat-color (Pearson, Lee, and Moore), average of 3 sets..	.633
Man, forearm, English (Pearson, '01[c]).........................	.542
Hound, coat-color, Bassett (Pearson and Lee, '00).	.526
Man, eye-color, English (Pearson, '01[c]). Average of 2 sets	.475
Pectinatella, statoblast hooks (Pearson, '01[c])	.430
Man, stature " " Average of 3 sets..	.403
" cephalic index, N. A. Ind. " " Average of 3 sets..	.403
" longevity, Quakers (Beeton and Pearson, '01).	.332
" temper, British (Pearson, '01[c]).	.317
" longevity, British peerage (Pearson, '01)	.260
" " Quakers " " "	.197
Average of 23 sets.	.476
Mean of 42 fraternal correlations (Pearson, '02[k])..........	.495

Some mental characteristics, inherited exactly like physical characters (Pearson, '01[e]):

Conscientiousness	.593	Popularity...............	.504
Self-consciousness........	.592	Vivacity.................	.470
Shyness..................	.528	Intelligence.............	.456

Average of 6.. .507

Theoretical coefficient of correlation between relatives.—Pearson, '00, Pearson and Lee, '00.

	Blended Inheritance.	Alternative Inheritance.
Offspring and Parent	.3000	.5000
" " grandparent	.1500	.250
" " great-grandparent	.0750	.123
" " gt.-gt.-grandparent	.0375	
" " *n*th order grandparent	$.6\times(\frac{1}{2})^n$	
Brothers	.4000	.4 to 1.0
Half-brothers	.2000	.2 to 0.5
Uncle and nephew	.1500	.250
First cousins	.0750	
First cousins once removed	.0344	
Second cousins	.0172	
Third cousins	.0041	

Homotyposis.

Correlation in non-sexual reproduction, as in production of homologous undifferentiated physiologically independent parts, Pearson, '01[c]; criticism, Bateson, '01; reply, Pearson, '02[i]; rejoinder, Bateson, '03; correlation between differentiated homologous organs, Pearson, '02[e].

Lot.	Character.	% Var. to Var. of Race.	Correlation.
Ceteract, Somersetshire	Lobes on fronds	78	.631
Hartstongue, Somersetshire	Sori on fronds	78	.630
Shirley poppy, Chelsea	Stigmatic bands	79	.615
English onion. Hampden	Veins in tunics	79	.611
Holly Dorsetshire	Prickles on leaves	80	.599
Spanish chestnut, mixed	Veins in leaves	81	.591
Beech, Buckinghamshire	Veins in leaves	82	.570
Papaver rhœas, Hampden	Stigmatic bands	83	.562
Mushroom, Hampden	Gill indices	84	.549
Papaver rhœas, Quantocks	Stigmatic bands	85	.533
Shirley poppy. Hampden	Stigmatic bands	85	.524
Spanish chestnut, Buckinghamshire	Veins in leaves	89	.466
Broom, Yorkshire	Seeds in pods	91	.416
Ash. Monmouthshire	Leaflets on leaves	91	.405
Papaver rhœas, Lower Chilterns	Stigmatic bands	92	.400
Ash, Dorsetshire	Leaflets on leaves	92	.396
Ash Buckinghamshire	Leaflets on leaves	93	.374
Holly. Somersetshire	Prickles on leaves	93	.355
Wild ivy, mixed localities	Leaf indices	96	.273
Nigella hispanica, Slough	Seg. of seed-capsules.	98	.190
Malva rotundifolia, Hampden	Seg. of seed-vessels	98	.183
Woodruff, Buckinghamshire	Members of whorls	98	.173
Mean of 22 cases		87.4	.457
Bands of capsules of Shirley poppies, mean of 8 crops (Pearson, and others, '02)			.498
Mean of 39 cases of homotyposis (Pearson, '02[i])			.499

Mendelism.

General Statement.—Mendel, '66, de Vries, '00, '00[b], '00[c], '03, Correns, '00, Davenport, '01, Bateson, '02, Castle, '03; critical, Weldon, '02, '03, Pearson, '03[b].

Plants.—Correns, '00, '00[b], '01, '02–'02[c], '03–'03[c], de Vries, '02, '01–'03, Bateson and Saunders, '02.

Animals.—Echinoids, Doncaster, '03; poultry, Bateson and Saunders, '02; mice, Darbishire, '02, '03, '03[b], Castle, '03[b], Bateson, '03[b]; rabbits, Woods, '03.

Telegony.

No evidence of, in human statures, Pearson and Lee, '96.

Fertility.

Inherited in man and race-horses, Pearson, Lee, and Bramley-Moore, '99; greater fertility in poppy of seeds from capsules with a high number of stigmatic bands, Pearson, '02; fertility of medusæ with symmetrical bands exceeds that of the unsymmetrical as 3 to 4, Mayer, '01.

SELECTION.

General.—Intensity of selection connotes a lessening of correlation, Pearson, '02[d], p. 23; mediocre individuals not the fittest to survive, Pearson, '02[n], p. 50.

Man.—50% to 80% of human death-rate selective, Beeton and Pearson, '01.

Other Animals.—Annihilation of the extremes in the sparrow, Bumpus, '99; percentage death-rate of families of Aphids has inverse correlation with length of antenna of mother ($r=-.201\pm.084$), with frontal breadth of mother ($r=-.184\pm.084$), and with number in newly born brood ($r=-.188\pm.084$); in Carcinus mœnas, Weldon, '95, '99; in Clausilia, Weldon, '01.

Plants.—Transformation of skew frequency curve to a symmetrical one by selection, de Vries, '94, '98; shifting of the mode by selection, de Vries, '99.

Sexual.—Pearson, '96:

	A	σ
Stature of husbands, inches	$69.136\pm.126$	$2.628\pm.089$
" " males in general	$69.215\pm.066$	$2.592\pm.047$
" " wives	$63.869\pm.110$	$2.303\pm.078$
" " adult females in general	$64.043\pm.061$	$2.325\pm.043$

See also Correlation: Assortative mating (p. 75).

DISSYMMETRY.

The following values for Ξ have been determined by Duncker, '00 and '03:

Pleuronectes flesus L., 1060 R.-eyed and 60 L.-eyed:	Right-eyed.	Left-eyed.
Num. of pectoral divided rays	.997	−.983
Total num. pectoral rays.	.604	−.583
Num. of ventral divided rays.	.326	−.374
Total num. of ventral fin-rays.	.019	−.083
Gelasimus pugilator Latr. (fiddler-crab).	Right-handed.	Left-handed.
Lateral edge of carapace	.838	.793
Length of meropodite, first ambulacral appendage.	.813	.872
Length of meropodite, of carpopodite, and of propodite of chelæ, all	1.00	1.00

Num. of rays on R. and L. pectoral fins, Acerina	−0.111
" " glands on wrists of swine.	.0053

DIRECT EFFECT OF ENVIRONMENT.

Animals.—Aphids reared in successive generations in increasingly unfavorable conditions have reduced dimensions, Warren, '02:

	Grandmother.	Grandchildren.
Frontal breadth, Aphid. .	$A = 37.56$	33.93
Length of R. antenna. . . .	$A = 83.91$	76.59
Ratio $\frac{\text{F. B.}}{\text{R. A.}}$	$A = 22.46$	22.57

Depauperization of mud-snail, Nassa, in diluted sea-water, Dimon, '02.

Plants.—Conditions of life affect number of floral parts in poppy, de Vries, '99, MacLeod, '00, Pearson and others, '03; number of ray-flowers of Primula farinosa increases with moisture, Vogler, '01; empirical mode in number of anthers in Stellaria in poor environment is 3; in good environment 5, Reinöhl, '03; leaf-blade smaller in light than in shade, MacLeod, '98.

LOCAL RACES.

General.—Davenport and Blankenship, '98, Davenport, '99.

Pisces.—Leuciscus from different altitudes, Eigenmann, '95; herring from different sea-areas distinguishable, Heincke, '97, 98; mackerel from three Scotch localities differ, Williamson, '00; fin-rays of Pleuronectes from New England shore, Bumpus, '98:

	Wood Holl.	Waquoit.	Bristol, R. I.
Dorsal fin-rays. . .	$A = 66.1$	65.2	64.9
Anal " . . .	$A = 49.7$	48.6	48.7

Number of fin-rays of Pleuronectes flesus from Western Baltic, $M'=39$, southern North Sea $41\frac{1}{2}$, Plymouth 44, Duncker, '99.

Fish in similar and adjacent lakes belonging to different drainage-basins have marked difference in scales on nape, number of fin-rays and of dorsal spines, Moenkhaus, '96.

Invertebrata.—Mean and variability of deep- and shallow-water Eupagurus differ, Schuster, '03; proportions, variability, and correlation coefficients of Pecten opercularis differ at Eddystone, Irish Sea, and Firth of Forth, Davenport, '03b.

Plants.—Lesser celandine, Pearson and others, '03.

USEFUL TABLES.

Probability Integral.—Area and ordinate of normal curve in terms of abscissa, Sheppard, '98, '03; abscissa of normal curve in terms of ordinate, Sheppard, '98; abscissa and ordinate in terms of difference of area, Sheppard, '03; abscissa of normal curve in terms of class index, Sheppard, '98.

Probability of fitted curve being the true one:

$$P=e^{-\frac{1}{2}\chi^2}\left(1+\frac{\chi^2}{2}+\frac{\chi^4}{2\,.\,4}+\frac{\chi^6}{2\,.\,4\,.\,6}+\ldots+\frac{\chi^{n'-3}}{2\,.\,4\,.\,6\ldots(n'-3)}\right),$$

Elderton, '02.

Values of $\log\left\{\chi\sqrt{\frac{2}{\pi}}e^{-\frac{1}{2}\chi^2}\right\}$ for various values of χ^2. Elderton, '02.

Table of $\log\dfrac{1}{n(n-2)(n-4)\ldots}$. Elderton, '02.

Table of $\sqrt{\frac{2}{\pi}}\int_\chi^\infty e^{-\frac{1}{2}\chi^2}d\chi$, for different values of χ, Elderton, '02.

Table of $\log_{10}(1+x)-x\log_{10}e$ for various values of x, for use with curves of Type III.

Tables for calculating probable error, Sheppard, '98.

Table of values of $1-r^2$ and $\sqrt{1-r^2}$ for all values of r from 0 to 1 proceeding by hundredths, Yule, '97.

Probable errors of r for all values of n, Yule, '97.

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ABBREVIATIONS.

The following names of journals often referred to have been much abbreviated:

Amer. Nat. = American Naturalist.

Ber. d. deutsch. bot. Ges. = Berichte der deutschen botanischen Gesellschaft.

Biom. = Biometrika.

Bot. Centralbl. = Botanisches Centralblatt.

Phil. Trans. = Philosophical Transactions of the Royal Society of London.

Proc. Roy. Soc. = Proceedings of the Royal Society of London.

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EXPLANATION OF TABLES.

I. **Formulas.** In this table the principal formulas used in the calculation of curves are brought together for convenient reference. The meanings of the letters are explained in the text. This table is preceded by an index to the principal letters used in the formulæ of this book.

II. **Certain constants and their logarithms.** This table includes the constants most frequently employed in the calculations of this book.

III. **Table of ordinates of normal curve.** This table is for comparison of a normal frequency polygon consisting of weighted ordinates with the theoretical curve.

Example: $A=17.673$; $\sigma=1.117$; $y_0=181.4$. (See page 26.)

V	$V-M$	$\frac{V-M}{\sigma}$	Entries in Table corresponding to $\frac{V-M}{\sigma}$	y_0	y	f
14	−3.673	3.29	.00449	×181.4 =	0.8	1
15	−2.673	2.39	.05750	×181.4 =	10.4	8
16	−1.673	1.50	.32465	×181.4 =	58.9	63

IV. **Table of values of probability integral.** This table is for comparison of a normal frequency polygon consisting of rectangles with the theoretical curve.

Example: $A=17.673$; $\sigma=1.1169$. (See page 26.)

Class.	$\frac{x}{\sigma}$	Per cent.	Class Limits.	Deviation from $A=x_1$	$\frac{x_1}{\sigma}$	$(\frac{1}{2}-\frac{1}{2}a)\times 100$ less $\sum_{x_1\div\sigma}^{\infty}$
14	−3.29	.2				.225
			14.5	−3.173	−2.841	
15	−2.39	1.6				2.364
			15.5	−2.173	−1.945	
16	−1.50	12.4				12.097
			16.5	−1.173	−1.050	
17	− .60	30.3				29.155
			17.5	−0.173	−0.155	
18	.29	32.3				33.194
			18.5	0.827	0.740	
19	1.19	18.9				17.873
			19.5	1.827	1.636	
20	2.08	3.9				4.524
			20.5	2.827	2.531	
21	2.98	0.4				.568
		100.0				100.000

In the example, the data of which are given on p. 26, the frequency between the limits is given in % column. The $\frac{x}{\sigma}$ of each limit (as an inner class limit) is found and the entries in Table IV corresponding to the limits are taken. Each such entry is subtracted from 0.50000, is multiplied by 100, and from the product is subtracted the total theoretical percentage of variates lying between the *outer* limit of the class and the corresponding extremity of the half curve. This gives the *theoretical* frequency of the class in question. The closeness of agreement of the last column with the "Per cent." column indicates the closeness of the observed frequency to the theoretical.

V. Table of log Γ functions of p. This table will enable one to solve the equations for y_0 given on page 32. The table gives the logarithms of the values of Γ functions only within the range $p = 1$ to 2. As all values of the function within these limits are less than 1, the mantissa of the logarithms is -1; but it is given in the table as $10 - 1 = 9$, as is usually done in logarithmic tables.

Supposing the quantity of which we wish to find the value reduced to the form $\Gamma(4.273)$. The value cannot be found directly because the value of p is larger than the numbers in the table (1 to 2). The solution is made by aid of the equation $\Gamma(p + 1) = p\Gamma(p)$, thus:

$$\begin{aligned}
\log \Gamma(1.273) &= 9.955185 \\
\log \quad 1.273 &= \underline{0.104828} \\
\log \Gamma(2.273) &= 0.060013 \\
\log \quad 2.273 &= \underline{0.356599} \\
\log \Gamma(3.273) &= 0.416612 \\
\log \quad 3.273 &= \underline{0.514946} \\
\log \Gamma(4.273) &= 0.931558
\end{aligned}$$

or, more briefly,

$$\begin{aligned}
\log \Gamma(1.273) &= 9.955185 \\
\log \quad 1.273 &= .104828 \\
\log \quad 2.273 &= .356599 \\
\log \quad 3.273 &= \underline{.514946} \\
\log \Gamma(4.273) &= 0.931558 = \log 8.542
\end{aligned}$$

VI. **Table of reduction from the common to the metric system.** This is given first for whole inches from 1 to 99 excepting even tens, which may be got from the first line of figures by shifting the decimal point one place to the right. The table may be used for hundredths of an inch by shifting the decimal point two places to the left. Other fractions than decimals are given in the lower tables.

VII. **Table of minutes and seconds of arc in decimals of a degree.** This table will be found of use in the fitting of curves of Type IV (p. 33).

VIII. **First to sixth powers of integers from 1 to 30.** This table is useful in calculating moments.

IX. **Table of the probable errors of the coefficient of correlation for various numbers of observations or variates (n) and for various values of r.** The probable error of the coefficient of correlation being $\frac{0.6745(1-r^2)}{\sqrt{n}}$, a table for the varying values of n and r is easily constructed, and for large values of n is accurate with interpolation by inspection to two significant figures, which are all that are required.

X. **Squares, cubes, square roots, and reciprocals of numbers from 1 to 1054.** The use of this table can be extended by using the principle that if any number be multiplied by n, its square is multiplied by n^2, its cube by n^3, and its reciprocal by $\frac{1}{n}$.

XI. **Logarithms of numbers to six places.** The following explanation of the use of the logarithmic tables is taken from Searles' Field Engineering, pp. 257–263 [ed. 1887].

The logarithm of a number consists of two parts, a whole number, called the *characteristic*, and a decimal, called the *mantissa*. All numbers which consist of the same figures standing in the same order have the same mantissa, regardless of the position of the decimal point in the number, or of the number of ciphers which precede or follow the significant figures of the number. The value of the characteristic depends entirely on the position of the decimal point

in the number. It is always one less than the number of figures in the number to the left of the decimal point. The value is therefore diminished by one every time the decimal point of the number is removed one place to the left, and *vice versa.* Thus

Number.	*Logarithm.*
13840.	4.141136
1384.0	3.141136
138.40	2.141136
13.84	1.141136
1.384	0.141136
.1384	—1.141136
.01384	—2.141136
.001384	—3.141136
etc.	etc.

The mantissa is always positive even when the characteristic is negative. We may avoid the use of a negative characteristic by arbitrarily adding 10, which may be neglected at the close of the calculation. By this rule we have

Number.	*Logarithm.*
1.384	0.141136
.1384	9.141136
.01384	8.141136
.001384	7.141136
etc.	etc.

No confusion need arise from this method in finding a number from its logarithm; for although the logarithm 6.141136 represents either the number 1,384,000, or the decimal .0001384, yet these are so diverse in their values that we can never be uncertain in a given problem which to adopt.

TABLE XI. contains the mantissas of logarithms, carried to six places of decimals, for numbers between 1 and 9999, inclusive. The first three figures of a number are given in the first column, the fourth at the top of the other columns. The first two figures of the mantissa are given only in the second column, but these are understood to apply to the remaining four figures in either column following, which are comprised between the same horizontal lines with the two.

If a number (after cutting off the ciphers at either end) consists of not more than four figures, the mantissa may be taken direct from the table; but by interpolation the logarithm of a number having six figures may be obtained. The last column contains the average difference of consecutive logarithms on

the same line, but for a given case the difference needs to be verified by actual subtraction, at least so far as the last figure is concerned. The lower part of the page contains a complete list of differences, with their multiples divided by 10.

To find the logarithm of a number having six figures:—Take out the mantissa for the four superior places directly from the table, and find the difference between this mantissa and the next greater in the table. Add to the mantissa taken out the quantity found in the table of proportional parts, opposite the difference, and in the column headed by the fifth figure of the number; also add $\frac{1}{10}$ the quantity in the column headed by the sixth figure. The sum is the mantissa required, to which must be prefixed a decimal point and the proper characteristic.

Example.—Find the log of 23.4275.

For 2342 mantissa is	369587
" diff. 185 col. 7	129.5
" " " " 5	9.2
Ans. For 23.4275 log is	1.369726

The decimals of the corrections are added together to determine the nearest value of the sixth figure of the mantissa.

To find the number corresponding to a given logarithm.—If the given mantissa is not in the table find the one next less, and take out the four figures corresponding to it; divide the difference between the two mantissas by the tabular difference in that part of the table, and annex the figures of the quotient to the four figures already taken out. Finally, place the decimal point according to the rule for characteristics, prefixing or annexing ciphers if necessary. The division required is facilitated by the table of proportional parts, which furnishes by inspection the figures of the quotient.

Example.—Find the number of which the logarithm is 8.263927

		8.263927
First 4 figures 1836 from		263873
	Diff.	54.0
Tabular diff. = 236	∴ 5th fig. = 2	47.2
		6.80
	6th fig. = 3	7.08

Ans. No. = .0183623 or 183,623,000.

The number derived from a six-place logarithm is not reliable beyond the sixth figure.

At the end of Table XI is a small table of logarithms of numbers from 1 to 100, with the characteristic prefixed, for easy reference when the given number does not exceed two digits. But the same mantissas may be found in the larger table.

TABLE XII.—**The logarithmic sine, tangent, etc.,** of an arc is the logarithm of the natural sine, tangent, etc., of the same arc, but with 10 added to the characteristic to avoid negatives. This table gives log sines, tangents, cosines, and cotangents for every minute of the quadrant. With the number of degrees at the left side of the page are to be read the minutes in the left-hand column; with the degrees on the right-hand side are to be read the minutes in the right-hand column. When the degrees appear at the top of the page the top headings must be observed, when at the bottom those at the bottom. Since the values found for arcs in the first quadrant are duplicated in the second, the degrees are given from 0° to 180°. The differences in the logarithms due to a change of one second in the arc are given in adjoining columns.

To find the log. sin, cos, tan, or cot of a given arc.: Take out from the proper column of the table the logarithm corresponding to the given number of degrees and minutes. If there be any seconds multiply them by the adjoining tabular difference, and apply their product as a correction to the logarithm already taken out. The correction is to be *added* if the logarithms of the table are increasing with the angle, or *subtracted* if they are decreasing as the angle increases. In the first quadrant the log sines and tangents increase, and the log. cosines and cotangents decrease as the angle increases.

Example.—Find the log sin of 9° 28′ 20″.

Log sin of 9° 28′ is	9.216097
Add correction 20 × 12.62	252
Ans.	9.216349

Example.—Find the log cot of 9° 28′ 20″.

Log cotan of 9° 28′ is	10.777948
Subtract correction 20 × 12.97	259
Ans.	10.777689

To find the angle or arc corresponding to a given logarithmic sine, tangent, cosine, or cotangent.—If the given logarithm is found in the proper column take out the degrees and minutes directly; if not, find the two consecutive logarithms between which the given logarithm would fall, and adopt that one which corresponds to the least number of minutes; which minutes take out with the degrees, and divide the difference between this logarithm and the given one by the adjoining tabular difference for a quotient, which will be the required number of seconds.

With logarithms to six places of decimals the quotient is not reliable beyond the tenth of a second.

Example.—9.383731 is the log tan of what angle?

Next *less*	9.383682 gives	13° 36′
Diff.	49.00 ÷ 9.20 =	05″.3
	Ans.	13° 36′ 05″.3

Example.—9.249348 is the log cos of what angle?

Next *greater*	583 gives	79° 46′
Diff.	235 ÷ 11.67 =	20″.1
	Ans.	79° 46′ 20″.1

The above rules do not apply to the first two pages of this table (except for the column headed cosine at top) because here the differences vary so rapidly that interpolation made by them in the usual way will not give exact results.

On the first two pages, the *first* column contains the number of seconds for every minute from 1′ to 2°; the minutes are given in the *second*, the log. sin. in the *third*, and in the *fourth* are the last three figures of a logarithm which is the difference between the log sin and the logarithm of the number of seconds in the first column. The first three figures and the characteristic of this logarithm are placed, once for all, at the head of the column.

To find the log sin of an arc less than 2° given to seconds.—Reduce the given arc to seconds, and take the logarithm of the number of seconds from the table of logarithms, and *add* to this the logarithm from the fourth column opposite the same number of seconds. The sum is the log sin required.

The logarithm in the fourth column may need a slight interpolation of the last figure, to make it correspond closely to the given number of seconds.

Example.—Find the log sin of 1° 39′ 14″.4.

$$1° \, 39' \, 14''.4 = 5954''.4 \qquad \begin{array}{rr} \text{log} & 3.774838 \\ \text{add } (q - l) & \underline{4.685515} \\ \textit{Ans.} \text{ log sin} & 8.460353 \end{array}$$

Log tangents of small arcs are found in the same way, only taking the last four figures of $(q - l)$ from the *fifth* column.

Example.—Find the log tan of 0° 52′ 35″.

$$52' \, 35'' = (3120'' + 35'') = 3155'' \qquad \begin{array}{rr} \text{log} & 3.498999 \\ \text{add } (q - l) & \underline{4.685609} \\ \textit{Ans.} \quad \text{log tan} & 8.184608 \end{array}$$

To find the log cotangent of an angle less than 2° given to seconds.—Take from the column headed $(q + l)$ the logarithm corresponding to the given angle, interpolating for the last figure if necessary, and from this *subtract* the logarithm of the number of seconds in the given angle.

Example.—Find the log cotan of 1° 44′ 22″.5.

$$6240'' + 22''.5 = 6262.5 \qquad \begin{array}{rr} q + l & 15.314292 \\ \text{log} & \underline{3.796748} \\ \textit{Ans.} & 11.517544 \end{array}$$

These two pages may be used in the same way when the given angle lies between 88° and 92°, or between 178° and 180°; but if the number of degrees be found at the *bottom* of the page, the title of each column will be found there also; and if the number of degrees be found on the *right hand* side of the page, the number of minutes must be found in the right hand column, and since here the minutes increase upward, the number of seconds on the same line in the first column must be *diminished* by the odd seconds in the given angle to obtain the number whose logarithm is to be used with $(q \pm l)$ taken from the table.

Example.—Find the log cos of 88° 41′ 12″.5

$$4740'' - 12''.5 = 4727.5 \qquad \begin{array}{rr} (q - l) & 4.685537 \\ \text{log} & \underline{3.674631} \\ \textit{Ans.} & 8.360168 \end{array}$$

Example.—Find the log tan of 90° 30′ 50″.

$1800'' + 50'' = 1850''$	$q + l$	15.314413
	log	3.267172
	Ans.	$\overline{1}2.047241$

To find the arc corresponding to a given log sin, cos, tan, or cotan which falls within the limits of the first two pages of Table X. Find in the proper column two consecutive logarithms between which the given logarithm falls. If the title of the given function is found at the top of that column read the degrees from the top of the page; if at the bottom read from the bottom.

Find the value of $(q - l)$ or $(q + l)$, as the case may require, corresponding to the given log (interpolating for the last figure if necessary). Then if $q =$ given log and $l =$ log of number of seconds, n, in the required arc, we have at once $l = q - (q - l)$ or $l = (q + l) - q$, whence n is easily found.

Find in the first column two consecutive quantities between which the number n falls, and if the degrees are read from the *left hand* side of the page, adopt the *less*, take out the minutes from the second column, and take for the seconds the difference between the quantity adopted and the number n. But if the degrees are read from the *right hand* side of the page, adopt the *greater* quantity, take out the minutes on the same line from the right-hand column, and for the seconds take the difference between the number adopted and the number n.

Example.—11.734268 is the log cot of what arc?

$q + l$			15.314376
q			11.734268
$\therefore\ n =$	3802.8		3.580108
For 1° adopt	3780.	giving 03′	
Difference	22″.8		

Ans. 1° 03′ 22″.8 or 178° 56′ 37″.2.

Example.—8.201795 is the log cos of what arc?

$q - l$			4.685556
q			8.201795
$\therefore\ n =$	3282″.8		3.516239
For 89° adopt	3300.	giving 05′	
Difference	17″.2		

Ans. 89° 05′ 17″.2 or 90° 54′ 42″.8.

THE GREEK ALPHABET.

A α	Alpha	I ι	Iota	P ρ	Rho
B β	Beta	K κ	Kappa	Σ σ ς	Sigma
Γ γ	Gamma	Λ λ	Lamba	T τ	Tau
Δ δ	Delta	M μ	Mu	Υ υ	Upsilon
E ϵ	Epsilon	N ν	Nu	Φ ϕ	Phi
Z ζ	Zeta	Ξ ξ	Xi	X χ	Chi
H η	Eta	O o	Omicron	Ψ ψ	Psi
Θ θ ϑ	Theta	Π π	Pi	Ω ω	Omega

INDEX TO THE PRINCIPAL LETTERS USED IN THE FORMULÆ OF THIS BOOK.

A, average, mean.
a, class index (p. 24); also upper left-hand quadrant (p. 49).
α, skewness index.
b, the frequency of the upper right quadrant (p. 49).
β, ratio of moments.
C, coefficient of variability.
c, the frequency of the lower left quadrant (p. 49).
D, distance from mean to mode.
d, a difference; differential; the frequency of lower right quadrant (p. 49).
Δ, index of closeness of fit.
δ, difference between y and f.
E, probable error.
e, base of Naperian logarithms, $=2.718282$.
F, critical function.
f, class frequency.
G, geometric mean.
H, a function of h.
h, a fixed value of x; also, index of heredity.
I, interval between the p'th and p''th individual.
i, interval between the pth and $(p+1)$th individual (p. 27).
K, a function of k.
k, a fixed value of x.
L, limiting value of class.
l, range of curve along x.
l_1, l_2, portions of the curve range.
Λ, number of classes.
λ, class range.
M, abscissal value of the mode (theoretical).
M', abscissal value of the mode (empirical).
μ, moment about A.
N, the number corresponding to a log.
n, number of variates; area of polygon; any, not specified, number.
$\underline{|n}$, product of all integers from 1 to n.
ν, average moment about V_0.
Ξ, index of dissymmetry.
P, probability.
p, ordinal rank of a particular individual or case (p. 27); a root or power.
π, circumference in units of diameter, 3.14159.
q, a root or power.
r, coefficient of correlation.
ρ, coefficient of regression.
s, a relation of β's (p. 22).
Σ, summation sign.
σ, standard deviation; index of variability.
T, transmuting factor, σ into E, .67449.
τ, in Type IV.
$\left.\begin{array}{l}\theta,\\ \phi,\end{array}\right\}$ angles.
V, magnitude of any class.
V_0, magnitude of central class.
v, any variate or value.
$w=5\beta_2-6\beta_1-9$ (p. 31).
X, the horizontal axis or base of polygon.
x, a varying abscissal value.
x_1, x_2, etc., definite values of x.
χ, $\frac{x}{\sigma}$.
Y, the vertical axis of polygons; also the log of f (p. 29).
y, a varying ordinate value.
y_0, value of the ordinate at the origin.
z, ordinate value.

I. FORMULAS.

$$A=\frac{\Sigma(V.f)}{n}=V_0+\nu_1. \qquad E_A=\pm 0.6745\frac{\sigma}{\sqrt{n}}. \quad x=V-A$$

$$\sigma=\sqrt{\frac{\Sigma(x^2.f)}{n}}=\sqrt{\nu_2-\nu_1^2}=\sqrt{\mu_2}. \qquad E_\sigma=0.6745\frac{\sigma}{\sqrt{2n}}.$$

$$C=\frac{\sigma}{A}\times 100\%. \qquad E_c=0.6745\frac{C}{\sqrt{2n}}\left[1+2\left(\frac{C}{100}\right)^2\right]^{\frac{1}{2}}.$$

$$A.D.=\frac{\Sigma(x.f)}{n}=0.7979\sigma. \qquad E_{A.D.}=0.6745\sigma.$$

$$\nu_1=\frac{\Sigma(V-V_0)}{n}=A-V_0. \qquad \nu_2=\frac{\Sigma(V-V_0)^2}{n}.$$

$$\nu_3=\frac{\Sigma(V-V_0)^3}{n}. \qquad \nu_4=\frac{\Sigma(V-V_0)^4}{n}.$$

$$\mu_2=\nu_2-\nu_1^2+\left\{\frac{1}{12}\right\}=\frac{\Sigma(x^2.f)}{n}+\left\{\frac{1}{12}\right\}.$$

$$\mu_3=\nu_3-3\nu_1\nu_2+2\nu_1^3=\frac{\Sigma(x^3.f)}{n}.$$

$$\mu_4=\nu_4-4\nu_1\nu_3+6\nu_1^2\nu_2-3\nu_1^4+\left\{\frac{1}{2}(\nu_2-\nu_1^2)+\frac{7}{240}\right\}=$$

$$=\frac{\Sigma(x^4.f)}{n}+\left\{\frac{\Sigma(x^2.f)}{2n}+\frac{7}{240}\right\}.$$

$$\beta_1=\frac{\mu_3^2}{\mu_2^3}. \qquad \beta_2=\frac{\mu_4}{\mu_2^2}. \qquad s=\frac{6(\beta_2-\beta_1-1)}{3\beta_1-2\beta_2+6}.$$

$$F=\frac{\beta_1(\beta_2+3)^2}{4(4\beta_2-3\beta_1)(2\beta_2-3\beta_1-6)}. \qquad D=\sigma.A.$$

$$\alpha=\tfrac{1}{2}\sqrt{\beta_1}\,\frac{s\pm 2}{s\mp 2}\text{ (Types I, IV).} \qquad \alpha=\frac{2\sqrt{p-3}}{p}\text{ (Type V).}$$

Probable discrepancy, $\dfrac{0.6745\sigma}{\sqrt{n}}\left\{\dfrac{\pi}{2}\cdot\dfrac{(1-a^2)}{y^2}-\left(1+\dfrac{\chi^2}{2}\right)\right\}^{\frac{1}{2}}.$

$$r=\frac{\Sigma(\text{dev. }x\times\text{dev. }y\times f)}{n.\sigma_1.\sigma_2}=\frac{\Sigma(x_1x_2f)}{n\sigma_1\sigma_2}. \qquad E_r=\frac{0.6745(1-r^2)}{\sqrt{n}}.$$

r_0 (spurious correlation) $=\dfrac{C_3^2}{\sqrt{C_1^2+C_3^2}\sqrt{C_2^2+C_3^2}}.$

h (uniparental) $=r\dfrac{\sigma_1}{\sigma_2}$; h_1 (biparental) $=r_3\dfrac{\sigma_1}{\sigma_2}h_2+r_2\dfrac{\sigma_1}{\sigma_3}h_3.$

$$E_h=\frac{6745\sigma_1}{\sigma_2}\sqrt{\frac{1-r_{12}^2}{n}}.$$

To solve any equation of the second degree,

$$ax^2+bx+c=0;\quad x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}.$$

II.—CERTAIN CONSTANTS AND THEIR LOGARITHMS.

Title.	Symbol.	Number.	Log.
Ratio of circumference to diameter	π	3.1415927	0.4971499
Reciprocal of same	$\frac{1}{\pi}$	0.3183099	9.5028501
Square root of same	$\sqrt{\pi}$	1.7724538	0.2485749
Reciprocal of square root of same	$\frac{1}{\sqrt{\pi}}$	0.5641896	9.7514251
Square root of 2π	$\sqrt{2\pi}$	2.506628	0.399090
Reciprocal of same	$\frac{1}{\sqrt{2\pi}}$	0.3989422	9.6009101
Reciprocal of 2π	$\frac{1}{2\pi}$	0.159155	9.201820
Square root of 2	$\sqrt{2}$	1.4142136	0.150515
Reciprocal of same	$\frac{1}{\sqrt{2}}$	0.707105	9.8494849
Square root of $\frac{2}{\pi}$	$\sqrt{\frac{2}{\pi}}$	0.797816	9.9019401
Base of hyperbolic logarithms	e	2.7182818	0.4342945
Reciprocal of square root of same.......	$\frac{1}{\sqrt{e}}$	0.606530	9.7828528
Modulus of common system of logs = log e	m	0.4342945	9.6377843
Reciprocal of same = hyp. log 10	$\frac{1}{m}$	2.3025851	0.3622157
Factor to reduce σ to probable error.....	T	0.67449	9.828976
Com. log $x = m \times$ hyp. log x, or			
Com. log (com. log x) = 9.6377843 + com. log (hyp. log x)			
Hyp. log x = com. log $x \times \frac{1}{m}$, or			
Com. log(hyp. log x) = com. log (com. log) x + 0.3622157			
Circumference of circle	$2\pi r$		
Area of circle	πr^2		
Area of sector (length of arc = l)	$\frac{1}{2}lr$		
Area of sector (angle of arc = $a°$)	$\frac{a}{360}\pi r^2$		

Eccentricity of an ellipse, $\epsilon = \sqrt{\frac{a^2 - b^2}{a^2}}$, where a = semi-major axis; b = semi-minor axis of ellipse.

TABLE III.—TABLE OF ORDINATES (z) OF NORMAL CURVE, OR VALUES OF $\frac{y}{y_0}$ CORRESPONDING TO VALUES OF $\frac{x}{\sigma}$.

x = deviation from mean. y = frequency.

σ = standard deviation. $y_0 = \frac{n}{\sigma\sqrt{2\pi}}$ = maximum frequency.

x/σ	0	1	2	3	4	5	6	7	8	9
0.0	100000	99995	99980	99955	99920	99875	99820	99755	99685	99596
0.1	99501	99396	99283	99158	99025	98881	98728	98565	98393	98211
0.2	98020	97819	97609	97390	97161	96923	96676	96420	96156	95882
0.3	95600	95309	95010	94702	94387	94055	93723	93382	93034	92677
0.4	92312	91939	91558	91169	90774	90371	89961	89543	89119	88688
0.5	88250	87805	87353	86896	86432	85962	85488	85006	84519	84060
0.6	83527	83023	82514	82010	81481	80957	80429	79896	79359	78817
0.7	78270	77721	77167	76610	76048	75484	74916	74342	73769	73193
0.8	72615	72033	71448	70861	70272	69681	69087	68493	67896	67298
0.9	66698	66097	65494	64891	64287	63683	63077	62472	61865	61259
1.0	60653	60047	59440	58834	58228	57623	57017	56414	55810	55209
1.1	54607	54007	53409	52812	52214	51620	51027	50437	49848	49260
1.2	48675	48092	47511	46933	46357	45783	45212	44644	44078	43516
1.3	42956	42399	41845	41294	40747	40202	39661	39123	38589	38058
1.4	37531	37007	36487	35971	35459	34950	34445	33944	33447	32954
1.5	32465	31980	31500	31023	30550	30082	29618	29158	28702	28251
1.6	27804	27361	26923	26489	26059	25634	25213	24797	24385	23978
1.7	23575	23176	22782	22392	22008	21627	21251	20879	20511	20148
1.8	19790	19436	19086	18741	18400	18064	17732	17404	17081	16762
1.9	16448	16137	15831	15530	15232	14939	14650	14364	14083	13806
2.0	13534	13265	13000	12740	12483	12230	11981	11737	11496	11259
2.1	11025	10795	10570	10347	10129	09914	09702	09495	09290	09090
2.2	08892	08698	08507	08320	08136	07956	07778	07604	07433	07265
2.3	07100	06939	06780	06624	06471	06321	06174	06029	05888	05750
2.4	05614	05481	05350	05222	05096	04973	04852	04734	04618	04505
2.5	04394	04285	04179	04074	03972	03873	03775	03680	03586	03494
2.6	03405	03317	03232	03148	03066	02986	02908	02831	02757	02684
2.7	02612	02542	02474	02408	02343	02280	02218	02157	02098	02040
2.8	01984	01929	01876	01823	01772	01723	01674	01627	01581	01536
2.9	01492	01449	01408	01367	01328	01289	01252	01215	01179	01145
3	01111	00819	00598	00432	00309	00219	00153	00106	00073	00050
4	00034	00022	00015	00010	00006	00004	00003	00002	00001	00001
5	00000									

TABLE IV.—TABLE OF THE HALF CLASS INDEX ($\frac{1}{2}a$) VALUES OF THE NORMAL PROBABILITY INTEGRAL CORRESPONDING TO VALUES OF $\frac{x}{\sigma}$; OR THE FRACTION OF THE AREA OF THE CURVE BETWEEN THE LIMITS 0 AND $+\frac{x}{\sigma}$, OR 0 AND $-\frac{x}{\sigma}$.

Total area of curve assumed to be 100,000.

x = deviation from mean.

σ = standard deviation.

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
0.00	00000	40	80	120	159	199	239	279	319	359	40
0.01	0399	439	479	519	559	598	638	678	718	758	
0.02	0798	838	878	917	957	997	1037	1077	1117	1157	
0.03	1197	1237	1276	1316	1356	1396	1436	1476	1516	1555	
0.04	1595	1635	1675	1715	1755	1795	1834	1874	1914	1954	
0.05	1994	2034	2074	2113	2153	2193	2233	2273	2313	2352	
0.06	2392	2432	2472	2512	2551	2591	2631	2671	2711	2751	
0.07	2790	2830	2870	2910	2949	2989	3029	3069	3109	3148	
0.08	3188	3228	3268	3307	3347	3387	3427	3466	3506	3546	
0.09	3586	3625	3665	3705	3744	3784	3824	3864	3903	3943	
0.10	3983	4022	4062	4102	4141	4181	4221	4261	4300	4340	
0.11	4380	4419	4459	4498	4538	4578	4617	4657	4697	4736	
0.12	4776	4815	4855	4895	4934	4974	5013	5053	5093	5132	
0.13	5172	5211	5251	5290	5330	5369	5409	5448	5488	5527	
0.14	5567	5606	5646	5685	5725	5764	5804	5843	5883	5922	
0.15	5962	6001	6041	6080	6119	6159	6198	6238	6277	6317	
0.16	6356	6395	6435	6474	6513	6553	6592	6631	6671	6710	
0.17	6750	6789	6828	6867	6907	6946	6985	7025	7064	7103	
0.18	7142	7182	7221	7260	7299	7338	7378	7417	7456	7495	
0.19	7535	7574	7613	7652	7691	7730	7769	7809	7848	7887	
0.20	7926	7965	8004	8043	8082	8121	8160	8199	8238	8278	
0.21	8317	8356	8395	8434	8473	8512	8551	8590	8628	8667	39
0.22	8706	8745	8784	8823	8862	8901	8940	8979	9018	9057	
0.23	9095	9134	9173	9212	9250	9289	9328	9367	9406	9445	
0.24	9483	9522	9561	9600	9638	9677	9716	9754	9793	9832	
0.25	9871	9909	9948	9986	10025	10064	10102	10141	10180	10218	
0.26	10257	10295	10334	10372	10411	10449	10488	10526	10565	10603	
0.27	10642	10680	10719	10757	10796	10834	10872	10911	10949	10988	
0.28	11026	11064	11103	11141	11179	11217	11256	11294	11333	11371	
0.29	11409	11447	11485	11524	11562	11600	11638	11676	11715	11753	
0.30	11791	11829	11867	11905	11943	11981	12019	12058	12096	12134	
0.31	12172	12210	12248	12286	12324	12362	12400	12438	12476	12514	38
0.32	12552	12589	12627	12665	12703	12741	12778	12816	12854	12892	
0.33	12930	12968	13005	13043	13081	13118	13156	13194	13232	13269	
0.34	13307	13344	13382	13420	13457	13495	13533	13570	13608	13645	
0.35	13683	13720	13758	13795	13833	13870	13908	13945	13983	14020	

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
40	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0
39	3.9	7.8	11.7	15.6	19.5	23.4	27.3	31.2	35.1
38	3.8	7.6	11.4	15.2	19.0	22.8	26.6	30.4	34.2
37	3.7	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
0.36	14058	14095	14132	14169	14207	14244	14281	14319	14356	14393	
0.37	14431	14468	14505	14542	14579	14617	14654	14691	14728	14765	
0.38	14803	14840	14877	14914	14951	14988	15025	15062	15099	15136	37
0.39	15173	15210	15247	15284	15321	15357	15394	15431	15468	15505	
0.40	15542	15579	15616	15652	15689	15726	15763	15799	15836	15873	
0.41	15910	15946	15983	16019	16056	16093	16129	16166	16202	16239	
0.42	16276	16312	16348	16385	16421	16458	16494	16531	16567	16604	
0.43	16640	16676	16713	16749	16785	16821	16858	16894	16930	16967	
0.44	17003	17039	17075	17111	17147	17184	17220	17256	17292	17328	
0.45	17364	17400	17436	17472	17508	17544	17580	17616	17652	17688	36
0.46	17724	17760	17796	17831	17867	17903	17939	17975	18011	18046	
0.47	18082	18118	18153	18189	18225	18260	18296	18332	18367	18403	
0.48	18439	18474	18509	18545	18580	18616	18651	18687	18722	18758	
0.49	18793	18829	18864	18899	18934	18969	19005	19040	19075	19111	
0.50	19146	19181	19216	19251	19287	19322	19357	19392	19427	19462	
0.51	19497	19532	19567	19602	19637	19672	19707	19742	19777	19812	35
0.52	19847	19881	19916	19951	19986	20020	20055	20090	20125	20160	
0.53	20194	20229	20263	20298	20332	20367	20402	20436	20471	20505	
0.54	20540	20574	20609	20643	20678	20712	20746	20781	20815	20850	
0.55	20884	20918	20952	20986	21021	21055	21089	21123	21158	21192	
0.56	21226	21260	21294	21328	21362	21396	21430	21464	21498	21532	34
0.57	21566	21600	21634	21667	21701	21735	21769	21803	21836	21870	
0.58	21904	21938	21971	22005	22039	22072	22106	22139	22173	22207	
0.59	22240	22274	22307	22341	22374	22407	22441	22474	22508	22541	
0.60	22575	22608	22641	22674	22707	22741	22774	22807	22840	22874	
0.61	22907	22940	22973	23006	23039	23072	23105	23138	23171	23204	33
0.62	23237	23270	23303	23335	23368	23401	23434	23467	23499	23532	
0.63	23565	23598	23630	23663	23695	23728	23761	23793	23826	23859	
0.64	23891	23924	23956	23988	24021	24053	24085	24118	24150	24183	
0.65	24215	24247	24280	24312	24344	24376	24408	24441	24473	24505	
0.66	24537	24569	24601	24633	24665	24697	24729	24761	24793	24825	32
0.67	24857	24889	24920	24952	24984	25016	25048	25079	25111	25143	
0.68	25175	25206	25238	25269	25301	25332	25364	25395	25427	25459	
0.69	25490	25521	25553	25584	25615	25647	25678	25709	25741	25772	
0.70	25804	25835	25866	25897	25928	25959	25990	26021	26052	26084	
0.71	26115	26146	26176	26207	26238	26269	26300	26331	26362	26393	31
0.72	26424	26454	26485	26516	26546	26577	26608	26638	26669	26700	
0.73	26730	26761	26791	26822	26852	26883	26913	26943	26974	27004	
0.74	27035	27065	27095	27125	27156	27186	27216	27246	27277	27307	
0.75	27337	27367	27397	27427	27457	27437	27517	27547	27577	27607	30
0.76	27637	27667	27697	27726	27756	27786	27816	27845	27875	27905	
0.77	27935	27964	27994	28023	28053	28082	28112	28142	28171	28201	
0.78	28230	28260	28289	28318	28347	28377	28406	28435	28465	28494	
0.79	28524	28553	28582	28611	28640	28669	28698	28727	28756	28785	
0.80	28814	28843	28872	28901	28930	28958	28987	29016	29045	29074	29

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
37	3.7	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3
36	3.6	7.2	10.8	14.4	18.0	21.6	25.2	28.8	32.4
35	3.5	7.0	10.5	14.0	17.5	21.0	24.5	28.0	31.5
34	3.4	6.8	10.2	13.6	17.0	20.4	23.8	27.2	30.6
33	3.3	6.6	9.9	13.2	16.5	19.8	23.1	26.4	29.7
32	3.2	6.4	9.6	12.8	16.0	19.2	22.4	25.6	28.8
31	3.1	6.2	9.3	12.4	15.5	18.6	21.7	24.8	27.9
30	3.0	6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0
29	2.9	5.8	8.7	11.6	14.5	17.4	20.3	23.2	26.1

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
0.81	29103	29132	29160	29189	29217	29246	29274	29303	29332	29360	
0.82	29389	29417	29446	29474	29502	29531	29559	29588	29616	29645	
0.83	29673	29701	29729	29757	29785	29814	29842	29870	29898	29926	
0.84	29954	29982	30010	30038	30066	30094	30122	30150	30178	30206	28
0.85	30234	30261	30289	30317	30344	30372	30400	30427	30455	30483	
0.86	30510	30538	30565	30593	30620	30648	30675	30702	30730	30757	
0.87	30785	30812	30839	30866	30894	30921	30948	30975	31002	31030	
0.88	31057	31084	31111	31138	31165	31192	31219	31246	31273	31300	27
0.89	31327	31353	31380	31407	31433	31460	31487	31514	31540	31567	
0.90	31594	31620	31647	31673	31700	31726	31753	31780	31806	31832	
0.91	31859	31885	31911	31937	31964	31990	32016	32042	32069	32095	
0.92	32121	32147	32173	32199	32225	32251	32277	32303	32329	32355	26
0.93	32381	32407	32433	32459	32484	32510	32536	32562	32587	32613	
0.94	32639	32665	32690	32715	32741	32766	32792	32818	32843	32869	
0.95	32894	32919	32945	32970	32995	33021	33046	33071	33096	33122	
0.96	33147	33172	33197	33222	33247	33272	33297	33322	33347	33373	25
0.97	33398	33422	33447	33472	33497	33521	33546	33571	33596	33621	
0.98	33646	33670	33695	33719	33744	33768	33793	33817	33842	33867	
0.99	33891	33915	33940	33964	33988	34013	34037	34061	34086	34110	
1.00	34134	34158	34182	34206	34230	34255	34279	34303	34327	34351	24
1.01	34375	34399	34423	34446	34470	34494	34518	34542	34566	34590	
1.02	34613	34637	34661	34684	34708	34731	34755	34778	34802	34826	
1.03	34849	34873	34896	34919	34943	34966	34989	35013	35036	35059	
1.04	35083	35106	35129	35152	35175	35198	35221	35245	35268	35291	23
1.05	35314	35337	35360	35382	35405	35428	35451	35474	35497	35520	
1.06	35543	35565	35588	35610	35633	35656	35678	35701	35724	35746	
1.07	35769	35791	35814	35836	35858	35881	35903	35926	35948	35970	
1.08	35993										
......		015	037	059	081	103	125	148	170	192	22
1.09	36214	236	258	280	302	324	345	367	389	411	
1.10	433	455	477	498	520	541	563	585	607	628	
1.11	650	671	693	714	735	757	778	800	821	843	
1.12	864	885	906	928	949	970	991				
								012	034	055	
1.13	37176	097	118	139	160	181	202	223	244	265	21
1.14	286	306	327	348	368	389	410	430	451	472	
1.15	493	513	534	554	574	595	615	636	656	677	
1.16	697	718	738	758	778	798	819	839	859	880	
1.17	900	920	940	960	980						
						000	020	040	060	080	20
1.18	38100	120	139	159	179	199	218	238	258	278	
1.19	298	317	337	356	376	395	415	434	454	473	
1.20	493	512	531	551	570	589	609	628	647	667	

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
29	2.9	5.8	8.7	11.6	14.5	17.4	20.3	23.2	26.1
28	2.8	5.6	8.4	11.2	14.0	16.8	19.6	22.4	25.2
27	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3
26	2.6	5.2	7.8	10.4	13.0	15.6	18.2	20.8	23.4
25	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5
24	2.4	4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6
23	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7
22	2.2	4.4	6.6	8.8	11.0	13.2	15.4	17.6	19.8
21	2.1	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9
20	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0
19	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
1.21	38686	705	724	743	762	781	800	819	838	857	19
1.22	876	895	914	933	952	971	990	008	027	046	
1.23	39065	084	102	121	139	158	177	195	214	232	
1.24	251	270	288	306	324	343	361	380	398	417	
1.25	435	453	471	489	507	525	544	562	580	598	
1.26	617	634	652	670	688	706	724	742	760	778	18
1.27	796	813	831	849	866	884	902	920	937	955	
1.28	973	990	008	025	042	060	077	095	112	130	
1.29	40147	165	182	199	216	233	251	268	285	303	
1.30	320	337	354	371	388	405	422	439	456	473	17
1.31	490	507	524	540	557	574	591	608	625	641	
1.32	658	675	692	709	725	742	758	775	792	808	
1.33	825	841	857	873	889	906	922	938	955	971	
1.34	987	004	020	036	052	068	084	101	117	133	
1.35	41149	165	181	197	213	229	245	261	277	292	16
1.36	308	324	340	355	371	387	403	418	434	450	
1.37	466	481	497	512	527	543	558	574	590	605	
1.38	621	637	652	667	683	698	713	728	744	759	
1.39	774	789	804	819	834	849	864	879	894	909	15
1.40	924	939	954	969	984	998	013	028	043	058	
1.41	42073	088	102	117	131	146	161	175	190	205	
1.42	220	234	248	263	277	292	306	321	335	350	
1.43	364	378	393	407	421	435	449	464	478	492	
1.44	507	521	535	549	563	577	591	605	619	633	14
1.45	647	661	675	688	702	716	730	744	758	772	
1.46	785	799	813	826	840	854	867	881	895	908	
1.47	922	935	949	962	975	989	002	016	029	043	
1.48	43056	069	083	096	109	122	136	149	162	175	
1.49	189	202	215	228	241	254	267	280	293	306	13
1.50	319	332	345	358	371	383	396	409	422	435	
1.51	448	460	473	486	498	511	524	536	549	562	
1.52	574	587	599	612	624	637	649	662	674	687	
1.53	699	711	724	736	748	760	773	785	797	810	
1.54	822	834	846	858	870	882	894	906	919	931	12
1.55	943	955	967	978	990	002	014	026	038	050	
1.56	44062	074	085	097	109	120	132	144	156	167	
1.57	179	191	202	214	225	237	248	260	271	283	
1.58	295	306	317	329	340	351	363	374	385	397	
1.59	408	419	430	442	453	464	475	486	498	509	

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
19	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1
18	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2
17	1.7	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3
16	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4
15	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5
14	1.4	2.8	4.2	5.6	7.0	8.4	9.8	11.2	12.6
13	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7
12	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8
11	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
1.60	44520	531	542	553	564	575	586	597	608	619	11
1.61	630	641	652	662	673	684	695	706	717	727	
1.62	738	749	760	770	781	791	802	813	823	834	
1.63	845	855	866	876	887	897	908	918	929	939	
1.64	950	960	970	980	991						
						001	011	022	032	042	
1.65	45053	063	073	083	093	103	114	124	134	144	
1.66	154	164	174	184	194	204	214	224	234	244	10
1.67	254	264	274	283	293	303	313	323	332	342	
1.68	352	362	371	381	391	400	410	419	429	439	
1.69	449	458	467	477	486	496	505	515	524	534	
1.70	543	553	562	571	581	590	599	609	618	627	
1.71	637	646	655	664	673	682	692	701	710	719	
1.72	728	737	746	755	764	773	782	791	800	809	9
1.73	818	827	836	845	854	863	871	880	889	898	
1.74	907	916	924	933	942	950	959	968	977	985	
1.75	994										
		003	011	020	028	037	045	054	062	071	
1.76	46080	088	096	105	113	121	130	138	147	155	
1.77	164	172	180	188	196	205	213	221	230	238	
1.78	246	254	262	270	279	287	295	303	311	319	
1.79	327	335	343	351	359	367	375	383	391	399	8
1.80	407	415	423	430	438	446	454	462	469	477	
1.81	485	493	500	508	516	523	531	539	547	554	
1.82	562	570	577	585	592	600	607	615	622	630	
1.83	638	645	652	660	667	674	682	689	697	704	
1.84	712	719	726	733	741	748	755	762	770	777	
1.85	784	791	798	806	813	820	827	834	841	849	
1.86	856	863	870	877	884	891	898	905	912	919	7
1.87	926	933	939	946	953	960	967	974	981	988	
1.88	995										
		001	008	015	021	028	035	042	049	055	
1.89	47062	069	075	082	088	095	102	108	115	122	
1.90	128	135	141	148	154	161	167	174	180	187	
1.91	193	200	206	212	219	225	231	238	244	251	
1.92	257	263	270	276	282	288	294	301	307	313	
1.93	320	326	332	338	344	350	356	362	369	375	
1.94	381	387	393	399	405	411	417	423	429	435	6
1.95	441	447	453	459	465	471	476	482	488	494	
1.96	500	506	512	517	523	529	535	541	546	552	
1.97	558	564	569	575	581	586	592	598	603	609	
1.98	615	620	626	631	637	643	648	654	659	665	
1.99	670	676	681	687	692	698	703	709	714	719	
2.00	725	730	735	741	746	752	757	762	768	772	
2.01	778	784	789	794	799	804	810	815	820	826	
2.02	831	836	841	846	851	856	862	867	872	877	
2.03	882	887	892	897	902	907	912	917	922	927	5
2.04	932	937	942	947	952	957	962	967	972	977	

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
11	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9
10	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
9	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1
8	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2
7	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3
6	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
2.05	47982	987	991	996	001	006	011	015	020	025	
2.06	48030	035	039	044	049	054	058	063	068	073	
2.07	077	082	087	091	096	100	105	110	114	119	
2.08	124	128	133	137	142	146	151	155	160	165	
2.09	169	173	178	182	187	191	196	200	205	209	
2.10	214	218	222	227	231	235	240	244	248	253	
2.11	257	261	266	270	274	278	283	287	291	295	
2.12	300	304	308	312	316	320	325	329	333	337	
2.13	341	345	350	354	358	362	366	370	374	378	
2.14	382	386	390	394	398	402	406	410	414	418	4
2.15	422	426	430	434	438	442	446	450	453	457	
2.16	461	465	469	473	477	480	484	488	492	496	
2.17	500	503	507	511	515	518	522	526	530	533	
2.18	537	541	544	548	552	555	559	563	566	570	
2.19	574	577	581	584	588	592	595	599	602	606	
2.20	610	613	617	620	624	627	631	634	638	641	
2.21	645	648	652	655	658	662	665	669	672	676	
2.22	679	682	686	689	692	696	699	702	706	709	
2.23	713	716	719	722	726	729	732	736	739	742	
2.24	745	749	752	755	758	761	765	768	771	774	
2.25	778	781	784	787	790	793	796	799	803	806	
2.26	809	812	815	818	821	824	827	830	833	837	
2.27	840	843	846	849	852	855	858	861	864	867	3
2.28	870	872	875	878	881	884	887	890	893	896	
2.29	899	902	905	907	910	913	916	919	922	925	
2.30	928	930	933	936	939	942	944	917	950	953	
2.31	956	958	961	964	966	969	972	975	977	980	
2.32	983	986	988	991	994	996	999	002	004	007	
2.33	49010	012	015	017	020	023	025	028	031	033	
2.34	036	038	041	043	046	048	051	054	056	059	
2.35	061	064	066	069	071	074	076	079	081	084	
2.36	086	089	092	094	096	098	101	103	106	108	
2.37	111	113	115	118	120	122	125	127	130	132	
2.38	134	137	139	141	144	146	148	151	153	155	
2.39	158	160	162	164	167	169	171	173	176	178	
2.40	180	182	185	187	189	191	193	196	198	200	
2.41	202	205	207	209	211	213	215	217	220	222	
2.42	224	226	228	230	232	234	237	239	241	243	
2.43	245	247	249	251	253	255	257	259	261	264	
2.44	266	268	270	272	274	276	278	280	282	284	2
2.45	286	288	290	292	294	295	297	299	301	303	
2.46	305	307	309	311	313	315	317	319	321	323	
2.47	324	326	328	330	332	334	336	337	339	341	
2.48	343	345	347	349	350	352	354	356	358	359	
2.49	361	363	365	367	368	370	372	374	375	377	
2.5	379	396	413	430	446	461	477	492	506	520	16
2.6	534	547	560	573	585	598	609	621	632	643	12
2.7	653	664	674	683	693	702	711	720	728	736	9
2.8	744	752	760	767	774	781	788	795	801	807	7

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	9	9
16	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4
12	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8
9	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1
7	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3

TABLE IV.—*Continued.*

x/σ	0	1	2	3	4	5	6	7	8	9	Δ
2.9	49813	819	825	831	836	841	846	851	856	861	5
3.0	865	869	873	878	882	886	889	893	897	900	4
3.1	903	906	910	913	916	918	921	924	926	929	3
3.2	931	934	936	938	940	942	944	946	948	950	2
3.3	952	953	955	957	958	960	961	962	964	965	1
3.4	966	968	969	970	971	972	973	974	975	976	1
3.5	977	978	978	979	980	981	981	982	983	983	1
3.6	984	985	985	986	986	987	987	988	988	989	1
3.7	989	990	990	990	991	991	992	992	992	992	0
3.8	993	993	993	994	994	994	994	995	995	995	0
3.9	995	995	996	996	996	996	996	996	997	997	0
4	997	998	999	999	999	000	000	000	000	000	0

PROPORTIONAL PARTS.

Δ	1	2	3	4	5	6	7	8	9
5	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
4	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6
3	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7
2	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

V.—TABLE OF LOG Γ FUNCTIONS OF p (see pages 32–34).

p	0	1	2	3	4	5	6	7	8	9
1.00	....	9750	9500	9251	9003	8755	8509	8263	8017	7773
1.01	9.997529	7285	7043	6801	6560	6320	6080	5841	5602	5365
1.02	5128	4892	4656	4421	4187	3953	3721	3489	3257	3026
1.03	2796	2567	2338	2110	1883	1656	1430	1205	0981	0757
1.04	0533	0311	0089	$\bar{9}868$	$\bar{9}647$	$\bar{9}427$	$\bar{9}208$	$\bar{8}989$	$\bar{8}772$	$\bar{8}554$
1.05	9.988338	8122	7907	7692	7478	7265	7052	6841	6629	6419
1.06	6209	6000	5791	5583	5376	5169	4963	4758	4553	4349
1.07	4145	3943	3741	3539	3338	3138	2939	2740	2541	2344
1.08	2147	1951	1755	1560	1365	1172	0978	0786	0594	0403
1.09	0212	0022	$\bar{9}833$	$\bar{9}644$	$\bar{9}456$	$\bar{9}269$	$\bar{9}082$	$\bar{8}896$	$\bar{8}710$	$\bar{8}525$
1.10	9.978341	8157	7974	7791	7610	7428	7248	7068	6888	6709
1.11	6531	6354	6177	6000	5825	5650	5475	5301	5128	4955
1.12	4783	4612	4441	4271	4101	3932	3764	3596	3429	3262
1.13	3096	2931	2766	2602	2438	2275	2113	1951	1790	1629
1.14	1469	1309	1150	0992	0835	0677	0521	0365	0210	0055
1.15	9.969901	9747	9594	9442	9290	9139	8988	8838	8688	8539
1.16	8390	8243	8096	7949	7803	7658	7513	7369	7225	7082
1.17	6939	6797	6655	6514	6374	6234	6095	5957	5818	5681
1.18	5544	5408	5272	5137	5002	4868	4734	4601	4469	4337
1.19	4205	4075	3944	3815	3686	3557	3429	3302	3175	3048
1.20	2922	2797	2672	2548	2425	2302	2179	2057	1936	1815
1.21	1695	1575	1456	1337	1219	1101	0984	0867	0751	0636
1.22	0521	0407	0293	0180	0067	9955	8843	9732	9621	9511
1.23	9.959401	9292	9184	9076	8968	8861	8755	8649	8544	8439
1.24	8335	8231	8128	8025	7923	7821	7720	7620	7520	7420
1.25	7321	7223	7125	7027	6930	6834	6738	6642	6547	6453
1.26	6359	6267	6173	6081	5989	5898	5807	5716	5627	5537
1.27	5449	5360	5273	5185	5099	5013	4927	4842	4757	4673
1.28	4589	4506	4423	4341	4259	4178	4097	4017	3938	3858
1.29	3780	3702	3624	3547	3470	3394	3318	3243	3168	3094
1.30	3020	2947	2874	2802	2730	2659	2588	2518	2448	2379
1.31	2310	2242	2174	2106	2040	1973	1907	1842	1777	1712
1.32	1648	1585	1522	1459	1397	1336	1275	1214	1154	1094
1.33	1035	0977	0918	0861	0803	0747	0690	0634	0579	0524
1.34	0470	0416	0362	0309	0257	0205	0153	0102	0051	0001
1.35	9.949951	9902	9853	9805	9757	9710	9663	9617	9571	9525
1.36	9480	9435	9391	9348	9304	9262	9219	9178	9136	9095
1.37	9054	9015	8975	8936	8898	8859	8822	8785	8748	8711
1.38	8676	8640	8605	8571	8537	8503	8470	8437	8405	8373
1.39	8342	8311	8280	8250	8221	8192	8163	8135	8107	8080
1.40	8053	8026	8000	7975	7950	7925	7901	7877	7854	7831
1.41	7808	7786	7765	7744	7723	7703	7683	7664	7645	7626
1.42	7608	7590	7573	7556	7540	7524	7509	7494	7479	7465
1.43	7451	7438	7425	7413	7401	7389	7378	7368	7358	7348
1.44	7338	7329	7321	7312	7305	7298	7291	7284	7278	7273
1.45	7268	7263	7259	7255	7251	7248	7246	7244	7242	7241
1.46	7240	7239	7239	7240	7241	7242	7243	7245	7248	7251
1.47	7254	7258	7262	7266	7271	7277	7282	7289	7295	7302
1.48	7310	7317	7326	7334	7343	7353	7363	7373	7384	7395
1.49	7407	7419	7431	7444	7457	7471	7485	7499	7515	7529

V.—TABLE OF LOG Γ FUNCTIONS OF p (see pages 32–34).

p	0	1	2	3	4	5	6	7	8	9
1.50	9.947545	7561	7577	7594	7612	7629	7647	7666	7685	7704
1.51	7724	7744	7764	7785	7806	7828	7850	7873	7896	7919
1.52	7943	7967	7991	8016	8041	8067	8093	8120	8146	8174
1.53	8201	8229	8258	8287	8316	8346	8376	8406	8437	8468
1.54	8500	8532	8564	8597	8630	8664	8698	8732	8767	8802
1.55	8837	8873	8910	8946	8983	9021	9059	9097	9135	9174
1.56	9214	9254	9294	9334	9375	9417	9458	9500	9543	9586
1.57	9629	9672	9716	9761	9806	9851	9896	9942	9989	6035
1.58	9.950082	0130	0177	0225	0274	0323	0372	0422	0472	0522
1.59	0573	0624	0676	0728	0780	0833	0886	0939	0993	1047
1.60	1102	1157	1212	1268	1324	1380	1437	1494	1552	1610
1.61	1668	1727	1786	1845	1905	1965	2025	2086	2147	2209
1.62	2271	2333	2396	2459	2522	2586	2650	2715	2780	2845
1.63	2911	2977	3043	3110	3177	3244	3312	3380	3449	3517
1.64	3587	3656	3726	3797	3867	3938	4010	4081	4154	4226
1.65	4299	4372	4446	4519	4594	4668	4743	4819	4894	4970
1.66	5047	5124	5201	5278	5356	5434	5513	5592	5671	5750
1.67	5830	5911	5991	6072	6154	6235	6317	6400	6482	6566
1.68	6649	6733	6817	6901	6986	7072	7157	7243	7329	7416
1.69	7503	7590	7678	7766	7854	7943	8032	8122	8211	8301
1.70	8391	8482	8573	8664	8756	8848	8941	9034	9127	9220
1.71	9314	9409	9502	9598	9693	9788	9884	9980	6077	6174
1.72	9.960271	0369	0467	0565	0664	0763	0862	0961	1061	1162
1.73	1262	1363	1464	1566	1668	1770	1873	1976	2079	2183
1.74	2287	2391	2496	2601	2706	2812	2918	3024	3131	3238
1.75	3345	3453	3561	3669	3778	3887	3996	4105	4215	4326
1.76	4436	4547	4659	4770	4882	4994	5107	5220	5333	5447
1.77	5561	5675	5789	5904	6019	6135	6251	6367	6484	6600
1.78	6718	6835	6953	7071	7189	7308	7427	7547	7666	7787
1.79	7907	8028	8149	8270	8392	8514	8636	8759	8882	9005
1.80	9129	9253	9377	9501	9626	9751	9877	6003	6129	6255
1.81	9.970383	0509	0637	0765	0893	1021	1150	1279	1408	1538
1.82	1668	1798	1929	2060	2191	2322	2454	2586	2719	2852
1.83	2985	3118	3252	3386	3520	3655	3790	3925	4061	4197
1.84	4333	4470	4606	4744	4881	5019	5157	5295	5434	5573
1.85	5712	5852	5992	6132	6273	6414	6555	6697	6838	6980
1.86	7123	7266	7408	7552	7696	7840	7984	8128	8273	8419
1.87	8564	8710	8856	9002	9149	9296	9443	9591	9739	9887
1.88	9.980036	0184	0333	0483	0633	0783	0933	1084	1234	1386
1.89	1537	1689	1841	1994	2147	2299	2453	2607	2761	2915
1.90	3069	3224	3379	3535	3690	3846	4003	4159	4316	4474
1.91	4631	4789	4947	5105	5264	5423	5582	5742	5902	6062
1.92	6223	6383	6544	6706	6867	7029	7192	7354	7517	7680
1.93	7844	8007	8171	8336	8500	8665	8830	8996	9161	9327
1.94	9494	9660	9827	9995	6162	6330	6498	6666	6835	1004
1.95	9.991173	1343	1512	1683	1853	2024	2195	2366	2537	2709
1.96	2881	3054	3227	3399	3573	3746	3920	4094	4269	4443
1.97	4618	4794	4969	5145	5321	5498	5674	5851	6029	6206
1.98	6384	6562	6740	6919	7098	7277	7457	7637	7817	7997
1.99	8178	8359	8540	8722	8903	9085	9268	9450	9633	9816

VI.—TABLE OF REDUCTION FROM COMMON TO METRIC SYSTEM.

	Inches to Millimeters.								
	1	2	3	4	5	6	7	8	9
....	25.40	50.80	76.20	101.60	127.00	152.40	177.80	203.20	228.60
10	279.40	304.80	330.19	355.59	380.99	406.39	431.79	457.19	482.59
20	533.39	558.79	584.19	609.59	634.99	660.39	685.79	711.19	736.59
30	787.39	812.79	838 19	863.59	888.99	914.39	939.78	965.18	990.58
40	1041.4	1066.8	1092.2	1117.6	1143.0	1168.4	1193.8	1219.2	1244.6
50	1295.4	1320.8	1346.2	1371.6	1397.0	1422.4	1447.8	1473.2	1498.6
60	1549.4	1574.8	1600.2	1625.6	1651.0	1676.4	1701.8	1727.2	1752.6
70	1803.4	1828.8	1854.2	1879.6	1905.0	1930.4	1955.8	1981.2	2006.6
80	2057.4	2082.8	2108.2	2133.6	2159.0	2184.4	2209.8	2235.2	2260.6
90	2311.4	2336.8	2362.2	2387.6	2413.0	2438.4	2463.8	2489.2	2514.6

Twelfths.			
1/12	2.12	7/12	14.82
2/12	4.23	8/12	16.93
3/12	6.35	9/12	19.05
4/12	8.47	10/12	21.17
5/12	10.58	11/12	23.28
6/12	12.70	12/12	25.40

Sixteenths.							
1/16	1.59	5/16	7.94	9/16	14.29	13/16	20.64
1/8	3.17	3/8	9.52	5/8	15.87	7/8	22.22
3/16	4.76	7/16	11.11	11/16	17.46	15/16	23.81
1/4	6.35	1/2	12.70	3/4	19.05	1	25.40

TABLE VII.—MINUTES AND SECONDS IN DECIMALS OF A DEGREE.

′	°	′	°	′	°	″	°	″	°	″	°
1	.016666	21	.350000	41	.683333	1	.000278*	21	.005833	41	.011389
2	.033333	22	.366666	42	.700000	2	.000556	22	.006111	42	.011667
3	.050000	23	.383333	43	.716666	3	.000833	23	.006389	43	.011944
4	.066666	24	.400000	44	.733333	4	.001111	24	.006667	44	.012222
5	.083333	25	.416666	45	.750000	5	.001389	25	.006944	45	.012500
6	.100000	26	.433333	46	.766666	6	.001667	26	.007222	46	.012778
7	.116666	27	.450000	47	.783333	7	.001944	27	.007500	47	.013056
8	.133333	28	.466666	48	.800000	8	.002222	28	.007778	48	.013333
9	.150000	29	.483333	49	.816666	9	.002500	29	.008056	49	.013611
10	.166666	30	.500000	50	.833333	10	.002778	30	.008333	50	.013889
11	.183333	31	.516666	51	.850000	11	.003056	31	.008611	51	.014167
12	.200000	32	.533333	52	.866666	12	.003333	32	.008889	52	.014444
13	.216666	33	.550000	53	.883333	13	.003611	33	.009167	53	.014722
14	.233333	34	.566666	54	.900000	14	.003889	34	.009444	54	.015000
15	.250000	35	.583333	55	.916666	15	.004167	35	.009722	55	.015278
16	.266666	36	.600000	56	.933333	16	.004444	36	.010000	56	.015556
17	.283333	37	.616666	57	.950000	17	.004722	37	.010278	57	.015833
18	.300000	38	.633333	58	.966666	18	.005000	38	.010556	58	.016111
19	.316666	39	.650000	59	.983333	19	.005278	39	.010833	59	.016389
20	.333333	40	.666666	60	1.000000	20	.005556	40	.011111	60	.016667

* .0002777778.

TABLE VIII.—FIRST TO SIXTH POWERS OF INTEGERS FROM 1 TO 50.

Powers.					
First.	Second.	Third.	Fourth.	Fifth.	Sixth.
1	1	1	1	1	1
2	4	8	16	32	64
3	9	27	81	243	729
4	16	64	256	1024	4096
5	25	125	625	3125	15625
6	36	216	1296	7776	46656
7	49	343	2401	16807	117649
8	64	512	4096	32768	262144
9	81	729	6561	59049	531441
10	100	1000	10000	100000	1000000
11	121	1331	14641	161051	1771561
12	144	1728	20736	248832	2985984
13	169	2197	28561	371293	4826809
14	196	2744	38416	537824	7529536
15	225	3375	50625	759375	11390625
16	256	4096	65536	1048576	16777216
17	289	4913	83521	1419857	24137569
18	324	5832	104976	1889568	34012224
19	361	6859	130321	2476099	47045881
20	400	8000	160000	3200000	64000000
21	441	9261	194481	4084101	85766121
22	484	10648	234256	5153632	113379904
23	529	12167	279841	6436343	148035889
24	576	13824	331776	7962624	191102976
25	625	15625	390625	9765625	244140625
26	676	17576	456976	11881376	308915776
27	729	19683	531441	14348907	387420489
28	784	21952	614656	17210368	481890304
29	841	24389	707281	20511149	594823321
30	900	27000	810000	24300000	729900000
31	961	29791	923521	28629151	887503681
32	1024	32768	1048576	33554432	1073741824
33	1089	35937	1185921	39135393	1291467969
34	1156	39304	1336336	45435424	1544804416
35	1225	42875	1500625	52521875	1838265625
36	1296	46656	1679616	60464176	2176782336
37	1369	50653	1874161	69343957	2565726409
38	1444	54872	2085136	79235168	3010936384
39	1521	59319	2313441	90224199	3518743761
40	1600	64000	2560000	102400000	4096000000
41	1681	68921	2825761	115856201	4750104241
42	1764	74088	3111696	130691232	5489031744
43	1849	79507	3418801	147008443	6321363049
44	1936	85184	3748096	164916224	7256313856
45	2025	91125	4100625	184528125	8303765625
46	2116	97336	4477456	205962976	9474296896
47	2209	103823	4879681	229345007	10779215329
48	2304	110592	5308416	254803968	12230590464
49	2401	117649	5764801	282475249	13841287201
50	2500	125000	6250000	312500000	15625000000

TABLE IX.—PROBABLE ERRORS OF THE COEFFICIENT OF CORRELATION FOR VARIOUS NUMBERS OF OBSERVATIONS OR VARIATES (n) AND FOR VARIOUS VALUES OF r.

Decimal point, properly preceding each entry, is omitted. (Specially Calculated.)

Number of Observations-	Correlation Coefficient r.						
	0.0	0.1	0.2	0.3	0.4	0.5	0.6
20	1508	1493	1448	1373	1267	1131	0965
30	1231	1219	1182	1121	1035	0924	0788
40	1067	1056	1024	0971	0896	0800	0683
50	0954	0944	0915	0868	0801	0715	0610
60	0871	0862	0836	0793	0731	0653	0557
70	0806	0798	0774	0734	0677	0605	0516
80	0754	0747	0724	0686	0633	0566	0483
90	0711	0704	0683	0647	0597	0533	0455
100	0674	0668	0648	0614	0567	0506	0432
150	0551	0546	0529	0501	0463	0413	0352
200	0477	0472	0458	0434	0401	0358	0305
250	0426	0421	0409	0387	0358	0319	0272
300	0389	0386	0374	0354	0327	0292	0249
400	0337	0334	0324	0307	0283	0253	0216
500	0302	0299	0290	0274	0253	0226	0193
600	0275	0272	0264	0251	0232	0207	0176
700	0255	0252	0245	0232	0214	0191	0163
800	0239	0236	0229	0217	0200	0179	0153
900	0225	0222	0216	0205	0189	0169	0144
1000	0213	0211	0205	0194	0179	0160	0137
2000	0151	0149	0145	0137	0127	0113	0097
5000	0095	0094	0092	0087	0080	0072	0061
	0.65	0.7	0.75	0.8	0.85	0.9	0.95
20	0871	0769	0660	0543	0419	0287	0147
30	0711	0628	0539	0444	0342	0234	0120
40	0616	0544	0467	0384	0296	0203	0104
50	0551	0486	0417	0343	0265	0181	0093
60	0503	0444	0381	0313	0241	0165	0085
70	0466	0411	0353	0290	0224	0153	0079
80	0436	0385	0330	0271	0209	0143	0074
90	0411	0363	0311	0256	0197	0135	0069
100	0391	0345	0294	0242	0187	0128	0066
150	0318	0281	0241	0198	0153	0105	0054
200	0275	0243	0209	0172	0133	0091	0047
250	0246	0218	0187	0154	0118	0081	0042
300	0225	0199	0170	0140	0108	0074	0038
400	0195	0172	0148	0122	0094	0064	0033
500	0174	0154	0132	0109	0084	0057	0029
600	0159	0140	0121	0099	0076	0052	0027
700	0147	0130	0112	0092	0071	0049	0025
800	0138	0122	0105	0086	0066	0045	0023
900	0130	0114	0098	0081	0062	0043	0022
1000	0123	0109	0093	0077	0059	0041	0021
2000	0087	0077	0066	0054	0042	0029	0014
5000	0055	0049	0042	0034	0026	0018	0009

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
1	1	1	1.0000000	1.0000000	1.000000000
2	4	8	1.4142136	1.2599210	.500000000
3	9	27	1.7320508	1.4422496	.333333333
4	16	64	2.0000000	1.5874011	.250000000
5	25	125	2.2360680	1.7099759	.200000000
6	36	216	2 4494897	1.8171206	.166666667
7	49	343	2.6457513	1.9129312	.142857143
8	64	512	2.8284271	2.0000000	.125000000
9	81	729	3.0000000	2.0800837	.111111111
10	100	1000	3.1622777	2.1544347	.100000000
11	121	1331	3.3166248	2.2239801	.090909091
12	144	1728	3.4641016	2.2894286	.083333333
13	169	2197	3.6055513	2.3513347	.076923077
14	196	2744	3.7416574	2.4101422	.071428571
15	225	3375	3.8729833	2.4662121	.066666667
16	256	4096	4.0000000	2.5198421	.062500000
17	289	4913	4.1231056	2.5712816	.058823529
18	324	5832	4.2426407	2.6207414	.055555556
19	361	6859	4.3588989	2.6684016	.052631579
20	400	8000	4.4721360	2.7144177	.050000000
21	441	9261	4.5825757	2.7589243	.047619048
22	484	10648	4.6904158	2.8020393	.045454545
23	529	12167	4.7958315	2.8438670	.043478261
24	576	13824	4.8989795	2.8844991	.041666667
25	625	15625	5.0000000	2.9240177	.040000000
26	676	17576	5.0990195	2.9624960	.038461538
27	729	19683	5.1961524	3.0000000	.037037037
28	784	21952	5.2915026	3.0365889	.035714286
29	841	24389	5.3851648	3.0723168	.034482759
30	900	27000	5.4772256	3.1072325	.033333333
31	961	29791	5.5677644	3.1413806	.032258065
32	1024	32768	5.6568542	3.1748021	.031250000
33	1089	35937	5.7445626	3.2075343	030303030
34	1156	39304	5.8309519	3.2396118	.029411765
35	1225	42875	5.9160798	3.2710663	.028571429
36	1296	46656	6.0000000	3.3019272	.027777778
37	1369	50653	6.0827625	3.3322218	.027027027
38	1444	54872	6.1644140	3.3619754	.026315789
39	1521	59319	6.2449980	3.3912114	.025641026
40	1600	64000	6.3245553	3.4199519	.025000000
41	1681	68921	6.4031242	3.4482172	.024390244
42	1764	74088	6.4807407	3 4760266	.023809524
43	1849	79507	6.5574385	3.5033981	.023255814
44	1936	85184	6.6332496	3.5303483	.022727273
45	2025	91125	6.7082039	3.5568933	.022222222
46	2116	97336	6.7823300	3.5830479	.021739130
47	2209	103823	6.8556546	3.6088261	.021276600
48	2304	110592	6.9282032	3.6342411	.020833333
49	2401	117649	7.0000000	3.6593057	.020408163
50	2500	125000	7.0710678	3.6840314	.020000000
51	2601	132651	7.1414284	3.7084298	.019607843
52	2704	140608	7.2111026	3.7325111	.019230769
53	2809	148877	7.2801099	3.7562858	.018867925
54	2916	157464	7.3484692	3.7797631	.018518519
55	3025	166375	7.4161985	3.8029525	.018181818
56	3136	175616	7.4833148	3.8258624	.017857143
57	3249	185193	7.5498344	3.8485011	.017543860
58	3364	195112	7.6157731	3.8708766	.017241379
59	3481	205379	7.6811457	3.8929965	.016949153
60	3600	216000	7.7459667	3.9148676	.016666667
61	3721	226981	7.8102497	3.9364972	.016393443
62	3844	238328	7.8740079	3.9578915	.016129032

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
63	3969	250047	7.9372539	3.9790571	.015873016
64	4096	262144	8.0000000	4.0000000	.015625000
65	4225	274625	8.0622577	4.0207256	.015384615
66	4356	287496	8.1240384	4.0412401	.015151515
67	4489	300763	8.1853528	4.0615480	.014925373
68	4624	314432	8.2462113	4.0816551	.014705882
69	4761	328509	8.3066239	4.1015661	.014492754
70	4900	343000	8.3666003	4.1212853	.014285714
71	5041	357911	8.4261498	4.1408178	.014084507
72	5184	373248	8.4852814	4.1601676	.013888889
73	5329	389017	8.5440037	4.1793390	013698630
74	5476	405224	8.6023253	4.1983364	.013513514
75	5625	421875	8.6602540	4.2171633	.013333333
76	5776	438976	8.7177979	4.2358236	.013157895
77	5929	456533	8.7749644	4.2543210	.012987013
78	6084	474552	8.8317609	4.2726586	.012820513
79	6241	493039	8.8881944	4.2908404	.012658228
80	6400	512000	8.9442719	4.3088695	.012500000
81	6561	531441	9.0000000	4.3267487	.012345679
82	6724	551368	9.0553851	4.3444815	.012195122
83	6889	571787	9.1104336	4.3620707	.012048193
84	7056	592704	9.1651514	4.3795191	.011904762
85	7225	614125	9.2195445	4.3968296	.011764706
86	7396	636056	9.2736185	4.4140049	.011627907
87	7569	658503	9.3273791	4.4310476	.011494253
88	7744	681472	9.3808315	4.4479602	.011363636
89	7921	704969	9.4339811	4.4647451	.011235955
90	8100	729000	9.4868330	4.4814047	.011111111
91	8281	753571	9.5393920	4.4979414	.010989011
92	8464	778688	9.5916630	4.5143574	.010869565
93	8649	804357	9.6436508	4.5306549	.010752688
94	8836	830584	9.6953597	4.5468359	.010638298
95	9025	857375	9.7467943	4.5629026	.010526316
96	9216	884736	9.7979590	4.5788570	.010416667
97	9409	912673	9.8488578	4.5947009	.010309278
98	9604	941192	9.8994949	4.6104363	.010204082
99	9801	970299	9.9498744	4.6260650	.010101010
100	10000	1000000	10.0000000	4.6415888	.010000000
101	10201	1030301	10.0498756	4.6570095	.009900990
102	10404	1061208	10.0995049	4.6723287	.009803922
103	10609	1092727	10.1488916	4.6875482	.009708738
104	10816	1124864	10.1980390	4.7026694	.009615385
105	11025	1157625	10.2469508	4.7176940	.009523810
106	11236	1191016	10.2956301	4.7326235	.009433962
107	11449	1225043	10.3440804	4.7474594	.009345794
108	11664	1259712	10.3923048	4.7622032	.009259259
109	11881	1295029	10.4403065	4.7768562	.009174312
110	12100	1331000	10.4880885	4.7914199	.009090909
111	12321	1367631	10.5356538	4.8058955	.009009009
112	12544	1404928	10.5830052	4.8202845	.008928571
113	12769	1442897	10.6301458	4.8345881	.008849558
114	12996	1481544	10.6770783	4.8488076	.008771930
115	13225	1520875	10.7238053	4.8629442	.008695652
116	13456	1560896	10.7703296	4.8769990	.008620690
117	13689	1601613	10.8166538	4.8909732	.008547009
118	13924	1643032	10.8627805	4.9048681	.008474576
119	14161	1685159	10.9087121	4.9186847	.008403361
120	14400	1728000	10.9544512	4.9324242	.008333333
121	14641	1771561	11.00 0000	4.9460874	.008264463
122	14884	1815848	11.0453610	4.9596757	.008196721
123	15129	1860867	11.0905365	4.9731898	.008130081
124	15376	1906624	11.1355287	4.9866310	.008064516

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
125	15625	1953125	11.1803399	5.0000000	.008000000
126	15876	2000376	11.2249722	5.0132979	.007936508
127	16129	2048383	11.2694277	5.0265257	.007874016
128	16384	2097152	11.3137085	5.0396842	.007812500
129	16641	2146689	11.3578167	5.0527743	.007751938
130	16900	2197000	11.4017543	5.0657970	.007692308
131	17161	2248091	11.4455231	5.0787531	.007633588
132	17424	2299968	11.4891253	5.0916434	.007575758
133	17689	2352637	11.5325626	5.1044687	.007518797
134	17956	2406104	11.5758369	5.1172299	.007462687
135	18225	2460375	11.6189500	5.1299278	.007407407
136	18496	2515456	11.6619038	5.1425632	.007352941
137	18769	2571353	11.7046999	5.1551367	.007299270
138	19044	2628072	11.7473401	5.1676493	.007246377
139	19321	2685619	11.7898261	5.1801015	.007194245
140	19600	2744000	11.8321596	5.1924941	.007142857
141	19881	2803221	11.8743421	5.2048279	.007092199
142	20164	2863288	11.9163753	5.2171034	.007042254
143	20449	2924207	11.9582607	5.2293215	.006993007
144	20736	2985984	12.0000000	5.2414828	.006944444
145	21025	3048625	12.0415946	5.2535879	.006896552
146	21316	3112136	12.0830460	5.2656374	.006849315
147	21609	3176523	12.1243557	5.2776321	.006802721
148	21904	3241792	12.1655251	5.2895725	.006756757
149	22201	3307949	12.2065556	5.3014592	.006711409
150	22500	3375000	12.2474487	5.3132928	.006666667
151	22801	3442951	12.2882057	5.3250740	.006622517
152	23104	3511808	12.3288280	5.3368033	.006578947
153	23409	3581577	12.3693169	5.3484812	.006535948
154	23716	3652264	12.4096736	5.3601084	.006493506
155	24025	3723875	12.4498996	5.3716854	.006451613
156	24336	3796416	12.4899960	5.3832126	.006410256
157	24649	3869893	12.5299641	5 3946907	.006369427
158	24964	3944312	12.5698051	5.4061202	.006329114
159	25281	4019679	12.6095202	5.4175015	.006289308
160	25600	4096000	12.6491106	5.4288352	.006250000
161	25921	4173281	12.6885775	5.4401218	.006211180
162	26244	4251528	12.7279221	5.4513618	.006172840
163	26569	4330747	12.7671453	5.4625556	.006134969
164	26896	4410944	12.8062485	5.4737037	.006097561
165	27225	4492125	12.8452326	5.4848066	.006060606
166	27556	4574296	12.8840987	5.4958647	.006024096
167	27889	4657463	12 9228480	5.5068784	.005988024
168	28224	4741632	12.9614814	5.5178484	.005952381
169	28561	4826809	13.0000000	5.5287748	.005917160
170	28900	4913000	13.0384048	5.5396583	.005882353
171	29241	5000211	13.0766968	5.5504991	.005847953
172	29584	5088448	13.1148770	5.5612978	.005813953
173	29929	5177717	13.1529464	5.5720546	.005780347
174	30276	5268024	13 1909060	5.5827702	.005747126
175	30625	5359375	13.2287566	5.5934447	.005714286
176	30976	5451776	13.2664992	5.6040787	.005681818
177	31329	5545233	13.3041347	5.6146724	.005649718
178	31684	5639752	13 3416641	5.6252263	.005617978
179	32041	5735339	13.3790882	5.6357408	.005586592
180	32400	5832000	13.4164079	5.6462162	.005555556
181	32761	5929741	13.4536240	5.6566528	.005524862
182	33124	6028568	13.4907376	5.6670511	.005494505
183	33489	6128487	13.5277493	5 6774114	.005464481
184	33856	6229504	13.5646600	5.6877340	.005434783
185	34225	6331625	13.6014705	5.6980192	.005405405
186	34596	6434856	13.6381817	5.7082675	.005376344

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
187	34969	6539203	13.6747943	5.7184791	.005347594
188	35344	6644672	13.7113092	5.7286543	.005319149
189	35721	6751269	13.7477271	5.7387936	.005291005
190	36100	6859000	13.7840488	5.7488971	.005263158
191	36481	6967871	13.8202750	5.7589652	.005235602
192	36864	7077888	13.8564065	5.7689982	.005208333
193	37249	7189057	13.8924440	5.7789966	.005181347
194	37636	7301384	13.9283883	5.7889604	.005154639
195	38025	7414875	13.9642400	5.7988900	.005128205
196	38416	7529536	14.0000000	5.8087857	.005102041
197	38809	7645373	14.0356688	5.8186479	.005076142
198	39204	7762392	14.0712473	5.8284767	.005050505
199	39601	7880599	14.1067360	5.8382725	.005025126
200	40000	8000000	14.1421356	5.8480355	.005000000
201	40401	8120601	14.1774469	5.8577660	.004975124
202	40804	8242408	14.2126704	5.8674643	.004950495
203	41209	8365427	14.2478068	5.8771307	.004926108
204	41616	8489664	14.2828569	5.8867653	.004901961
205	42025	8615125	14.3178211	5.8963685	.004878049
206	42436	8741816	14.3527001	5.9059406	.004854369
207	42849	8869743	14.3874946	5.9154817	.004830918
208	43264	8998912	14.4222051	5.9249921	.004807692
209	43681	9129329	14.4568323	5.9344721	.004784689
210	44100	9261000	14.4913767	5.9439220	.004761905
211	44521	9393931	14.5258390	5.9533418	.004739336
212	44944	9528128	14.5602198	5.9627320	.004716981
213	45369	9663597	14.5945195	5.9720926	.004694836
214	45796	9800344	14.6287388	5.9814240	.004672897
215	46225	9938375	14.6628783	5.9907264	.004651163
216	46656	10077696	14.6969385	6.0000000	.004629630
217	47089	10218313	14.7309199	6.0092450	.004608295
218	47524	10360232	14.7648231	6.0184617	.004587156
219	47961	10503459	14.7986486	6.0276502	.004566210
220	48400	10648000	14.8323970	6.0368107	.004545455
221	48841	10793861	14.8660687	6.0459435	.004524887
222	49284	10941048	14.8996644	6.0550489	.004504505
223	49729	11089567	14.9331845	6.0641270	.004484305
224	50176	11239424	14.9666295	6.0731779	.004464286
225	50625	11390625	15.0000000	6.0822020	.004444444
226	51076	11543176	15.0332964	6.0911994	.004424779
227	51529	11697083	15.0665192	6.1001702	.004405286
228	51984	11852352	15.0996689	6.1091147	.004385965
229	52441	12008989	15.1327460	6.1180332	.004366812
230	52900	12167000	15.1657509	6.1269257	.004347826
231	53361	12326391	15.1986842	6.1357924	.004329004
232	53824	12487168	15.2315462	6.1446337	.004310345
233	54289	12649337	15.2643375	6.1534495	.004291845
234	54756	12812904	15.2970585	6.1622401	.004273504
235	55225	12977875	15.3297097	6.1710058	.004255319
236	55696	13144256	15.3622915	6.1797466	.004237288
237	56169	13312053	15.3948043	6.1884628	.004219409
238	56644	13481272	15.4272486	6.1971544	.004201681
239	57121	13651919	15.4596248	6.2058218	.004184100
240	57600	13824000	15.4919334	6.2144650	.004166667
241	58081	13997521	15.5241747	6.2230843	.004149378
242	58564	14172488	15.5563492	6.2316797	.004132231
243	59049	14348907	15.5884573	6.2402515	.004115226
244	59536	14526784	15.6204994	6.2487998	.004098361
245	60025	14706125	15.6524758	6.2573248	.004081633
246	60516	14886936	15.6843871	6.2658266	.004065041
247	61009	15069223	15.7162336	6.2743054	.004048583
248	61504	15252992	15.7480157	6.2827613	.004032258

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
249	62001	15438249	15.7797338	6.2911946	.004016064
250	62500	15625000	15.8113883	6.2996053	.004000000
251	63001	15813251	15.8429795	6.3079935	.003984064
252	63504	16003008	15.8745079	6.3163596	.003968254
253	64009	16194277	15.9059737	6.3247035	.003952569
254	64516	16387064	15.9373775	6.3330256	.003937008
255	65025	16581375	15.9687194	6.3413257	.003921569
256	65536	16777216	16.0000000	6.3496042	.003906250
257	66049	16974593	16.0312195	6.3578611	.003891051
258	66564	17173512	16.0623784	6.3660968	.003875969
259	67081	17373979	16.0934769	6.3743111	.003861004
260	67600	17576000	16.1245155	6.3825043	.003846154
261	68121	17779581	16.1554944	6.3906765	.003831418
262	68644	17984728	16.1864141	6.3988279	.003816794
263	69169	18191447	16.2172747	6.4069585	.003802281
264	69696	18399744	16.2480768	6.4150687	.003787879
265	70225	18609625	16.2788206	6.4231583	.003773585
266	70756	18821096	16.3095064	6.4312276	.003759398
267	71289	19034163	16.3401346	6.4392767	.003745318
268	71824	19248832	16.3707055	6.4473057	.003731343
269	72361	19465109	16.4012195	6.4553148	.003717472
270	72900	19683000	16.4316767	6.4633041	.003703704
271	73441	19902511	16.4620776	6.4712736	.003690037
272	73984	20123648	16.4924225	6.4792236	.003676471
273	74529	20346417	16.5227116	6.4871541	.003663004
274	75076	20570824	16.5529454	6.4950653	.003649635
275	75625	20796875	16.5831240	6.5029572	.003636364
276	76176	21024576	16.6132477	6.5108300	.003623188
277	76729	21253933	16.6433170	6.5186839	.003610108
278	77284	21484952	16.6733320	6.5265189	.003597122
279	77841	21717639	16.7032931	6.5343351	.003584229
280	78400	21952000	16.7332005	6.5421326	.003571429
281	78961	22188041	16.7630546	6.5499116	.003558719
282	79524	22425768	16.7928556	6.5576722	.003546099
283	80089	22665187	16.8226038	6.5654144	.003533569
284	80656	22906304	16.8522995	6.5731385	.003521127
285	81225	23149125	16.8819430	6.5808443	.003508772
286	81796	23393656	16.9115345	6.5885323	.003496503
287	82369	23639903	16.9410743	6.5962023	.003484321
288	82944	23887872	16.9705627	6.6038545	.003472222
289	83521	24137569	17.0000000	6.6114890	.003460208
290	84100	24389000	17.0293864	6.6191060	.003448276
291	84681	24642171	17.0587221	6.6267054	.003436426
292	85264	24897088	17.0880075	6.6342874	.003424658
293	85849	25153757	17.1172428	6.6418522	.003412969
294	86436	25412184	17.1464282	6.6493998	.003401361
295	87025	25672375	17.1755640	6.6569302	.003389831
296	87616	25934336	17.2046505	6.6644437	.003378378
297	88209	26198073	17.2336879	6.6719403	.003367003
298	88804	26463592	17.2626765	6.6794200	.003355705
299	89401	26730899	17.2916165	6.6868831	.003344482
300	90000	27000000	17.3205081	6.6943295	.003333333
301	90601	27270901	17.3493516	6.7017593	.003322259
302	91204	27543608	17.3781472	6.7091729	.003311258
303	91809	27818127	17.4068952	6.7165700	.003300330
304	92416	28094464	17.4355958	6.7239508	.003289474
305	93025	28372625	17.4642492	6.7313155	.003278689
306	93636	28652616	17.4928557	6.7386641	.003267974
307	94249	28934443	17.5214155	6.7459967	.003257329
308	94864	29218112	17.5499288	6.7533134	.003246753
309	95481	29503629	17.5783958	6.7606143	.003236246
310	96100	29791000	17.6068169	6.7678995	.003225806

TABLE X.—SQUARES, CUBES, SQUARE ROOTS,

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
311	96721	30080231	17.6351921	6.7751690	.003215434
312	97344	30371328	17.6635217	6.7824229	.003205128
313	97969	30664297	17.6918060	6.7896613	.003194888
314	98596	30959144	17.7200451	6.7968844	.003184713
315	99225	31255875	17.7482393	6.8040921	.003174603
316	99856	31554496	17.7763888	6.8112847	.003164557
317	100489	31855013	17.8044938	6.8184620	.003154574
318	101124	32157432	17.8325545	6.8256242	.003144654
319	101761	32461759	17.8605711	6.8327714	.003134796
320	102400	32768000	17.8885438	6.8399037	.003125000
321	103041	33076161	17.9164729	6.8470213	.003115265
322	103684	33386248	17.9443584	6.8541240	.003105590
323	104329	33698267	17.9722008	6.8612120	.003095975
324	104976	34012224	18.0000000	6.8682855	.003086420
325	105625	34328125	18.0277564	6.8753443	.003076923
326	106276	34645976	18.0554701	6.8823888	.003067485
327	106929	34965783	18.0831413	6.8894188	.003058104
328	107584	35287552	18.1107703	6.8964345	.003048780
329	108241	35611289	18.1383571	6.9034359	.003039514
330	108900	35937000	18.1659021	6.9104232	.003030303
331	109561	36264691	18.1934054	6.9173964	.003021148
332	110224	36594368	18.2208672	6.9243556	.003012048
333	110889	36926037	18.2482876	6.9313008	.003003003
334	111556	37259704	18.2756669	6.9382321	.002994012
335	112225	37595375	18.3030052	6.9451496	.002985075
336	112896	37933056	18.3303028	6.9520533	.002976190
337	113569	38272753	18.3575598	6.9589434	.002967359
338	114244	38614472	18.3847763	6.9658198	.002958580
339	114921	38958219	18.4119526	6.9726826	.002949853
340	115600	39304000	18.4390889	6.9795321	.002941176
341	116281	39651821	18.4661853	6.9863681	.002932551
342	116964	40001688	18.4932420	6.9931906	.002923977
343	117649	40353607	18.5202592	7.0000000	.002915452
344	118336	40707584	18.5472370	7.0067962	.002906977
345	119025	41063625	18.5741756	7 0135791	.002898551
346	119716	41421736	18.6010752	7.0203490	.002890173
347	120409	41781923	18.6279360	7.0271058	.002881844
348	121104	42144192	18.6547581	7.0338497	.002873563
349	121801	42508549	18.6815417	7.0405806	.002865330
350	122500	42875000	18.7082869	7.0472987	.002857143
351	123201	43243551	18.7349940	7.0540041	.002849003
352	123904	43614208	18.7616630	7.0606967	.002840909
353	124609	43986977	18.7882942	7.0673767	.002832861
354	125316	44361864	18.8148877	7.0740440	.002824859
355	126025	44738875	18.8414437	7.0806988	.002816901
356	126736	45118016	18.8679623	7.0873411	.002808989
357	127449	45499293	18.8944436	7.0939709	.002801120
358	128164	45882712	18.9208879	7.1005885	.002793296
359	128881	46268279	18.9472953	7.1071937	.002785515
360	129600	46656000	18.9736660	7.1137866	.002777778
361	130321	47045881	19.0000000	7.1203674	.002770083
362	131044	47437928	19.0262976	7.1269360	.002762431
363	131769	47832147	19.0525589	7.1334925	.002754821
364	132496	48228544	19.0787840	7.1400370	.002747253
365	133225	48627125	19.1049732	7.1465695	.002739726
366	133956	49027896	19.1311265	7.1530901	.002732240
367	134689	49430863	19.1572441	7.1595988	.002724796
368	135424	49836032	19.1833261	7.1660957	.002717391
369	136161	50243409	19.2093727	7.1725809	.002710027
370	136900	50653000	19.2353841	7.1790544	.002702703
371	137641	51064811	19.2613603	7.1855162	.002695418
372	138384	51478848	19.2873015	7.1919663	.002688172

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
373	139129	51895117	19.3132079	7.1984050	.002680965
374	139876	52313624	19.3390796	7.2048322	.002673797
375	140625	52734375	19.3649167	7.2112479	.002666667
376	141376	53157376	19.3907194	7.2176522	.002659574
377	142129	53582633	19.4164878	7.2240450	.002652520
378	142884	54010152	19.4422221	7.2304268	.002645503
379	143641	54439939	19.4679223	7.2367972	.002638522
380	144400	54872000	19.4935887	7.2431565	.002631579
381	145161	55306341	19.5192213	7.2495045	.002624672
382	145924	55742968	19.5448203	7.2558415	.002617801
383	146689	56181887	19.5703858	7.2621675	.002610966
384	147456	56623104	19.5959179	7.2684824	.002604167
385	148225	57066625	19.6214169	7.2747864	.002597403
386	148996	57512456	19.6468827	7.2810794	.002590674
387	149769	57960603	19.6723156	7.2873617	.002583979
388	150544	58411072	19.6977156	7.2936330	.002577320
389	151321	58863869	19.7230829	7.2998936	.002570694
390	152100	59319000	19.7484177	7.3061436	.002564103
391	152881	59776471	19.7737199	7.3123828	.002557545
392	153664	60236288	19.7989899	7.3186114	.002551020
393	154449	60698457	19.8242276	7.3248295	.002544529
394	155236	61162984	19.8494332	7.3310369	.002538071
395	156025	61629875	19.8746069	7.3372339	.002531646
396	156816	62099136	19.8997487	7.3434205	.002525253
397	157609	62570773	19.9248588	7.3495966	.002518892
398	158404	63044792	19.9499373	7.3557624	.002512563
399	159201	63521199	19.9749844	7.3619178	.002506266
400	160000	64000000	20.0000000	7.3680630	.002500000
401	160801	64481201	20.0249844	7.3741979	.002493766
402	161604	64964808	20.0499377	7.3803227	.002487562
403	162409	65450827	20.0748599	7.3864373	.002481390
404	163216	65939264	20.0997512	7.3925418	.002475248
405	164025	66430125	20.1246118	7.3986363	.002469136
406	164836	66923416	20.1494417	7.4047206	.002463054
407	165649	67419143	20.1742410	7.4107950	.002457002
408	166464	67917312	20.1990099	7.4168595	.002450980
409	167281	68417929	20.2237484	7.4229142	.002444988
410	168100	68921000	20.2484567	7.4289589	.002439024
411	168921	69426531	20.2731349	7.4349938	.002433090
412	169744	69934528	20.2977831	7.4410189	.002427184
413	170569	70444997	20.3224014	7.4470342	.002421308
414	171396	70957944	20.3469899	7.4530399	.002415459
415	172225	71473375	20.3715488	7.4590359	.002409639
416	173056	71991296	20.3960781	7.4650223	.002403846
417	173889	72511713	20.4205779	7.4709991	.002398082
418	174724	73034632	20.4450483	7.4769664	.002392344
419	175561	73560059	20.4694895	7.4829242	.002386635
420	176400	74088000	20.4939015	7.4888724	.002380952
421	177241	74618461	20.5182845	7.4948113	.002375297
422	178084	75151448	20.5426386	7.5007406	.002369668
423	178929	75686967	20.5669638	7.5066607	.002364066
424	179776	76225024	20 5912603	7.5125715	.002358491
425	180625	76765625	20.6155281	7.5184730	.002352941
426	181476	77308776	20.6397674	7.5243652	.002347418
427	182329	77854483	20.6639783	7.5302482	.002341920
428	183184	78402752	20.6881609	7.5361221	.002336449
429	184041	78953589	20.7123152	7.5419867	.002331002
430	184900	79507000	20.7364414	7.5478423	.002325581
431	185761	80062991	20.7605395	7.5536888	.002320186
432	186624	80621568	20.7846097	7.5595263	.002314815
433	187489	81182737	20.8086520	7.5653548	.002309469
434	188356	81746504	20.8326667	7.5711743	.002304147

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
435	189225	82312875	20.8566536	7.5769849	.002298851
436	190096	82881856	20.8806130	7.5827865	.002293578
437	190969	83453453	20.9045450	7.5885793	.002288330
438	191844	84027672	20.9284495	7.5943633	.002283105
439	192721	84604519	20.9523268	7.6001385	.002277904
440	193600	85184000	20.9761770	7.6059049	.002272727
441	194481	85766121	21.0000000	7.6116626	.002267574
442	195364	86350888	21.0237960	7.6174116	.002262443
443	196249	86938307	21.0475652	7.6231519	.002257336
444	197136	87528384	21.0713075	7.6288837	.002252252
445	198025	88121125	21.0950231	7.6346067	.002247191
446	198916	88716536	21.1187121	7.6403213	.002242152
447	199809	89314623	21.1423745	7.6460272	.002237136
448	200704	89915392	21.1660105	7.6517247	.002232143
449	201601	90518849	21.1896201	7.6574133	.002227171
450	202500	91125000	21.2132034	7.6630943	.002222222
451	203401	91733851	21.2367606	7.6687665	.002217295
452	204304	92345408	21.2602916	7.6744303	.002212389
453	205209	92959677	21.2837967	7.6800857	.002207506
454	206116	93576664	21.3072758	7.6857328	.002202643
455	207025	94196375	21.3307290	7.6913717	.002197802
456	207936	94818816	21.3541565	7.6970023	.002192982
457	208849	95443993	21.3775583	7.7026246	.002188184
458	209764	96071912	21.4009346	7.7082388	.002183406
459	210681	96702579	21.4242853	7.7138448	.002178649
460	211600	97336000	21.4476106	7.7194426	.002173913
461	212521	97972181	21.4709106	7.7250325	.002169197
462	213444	98611128	21.4941853	7.7306141	.002164502
463	214369	99252847	21.5174348	7.7361877	.002159827
464	215296	99897344	21.5406592	7.7417532	.002155172
465	216225	100544625	21.5638587	7.7473109	.002150538
466	217156	101194696	21.5870331	7.7528606	.002145923
467	218089	101847563	21.6101828	7.7584023	.002141328
468	219024	102503232	21.6333077	7.7639361	.002136752
469	219961	103161709	21.6564078	7.7694620	.002132196
470	220900	103823000	21.6794834	7.7749801	.002127660
471	221841	104487111	21.7025344	7.7804904	.002123142
472	222784	105154048	21.7255610	7.7859928	.002118644
473	223729	105823817	21.7485632	7.7914875	.002114165
474	224676	106496424	21.7715411	7.7969745	.002109705
475	225625	107171875	21.7944947	7.8024538	.002105263
476	226576	107850176	21.8174242	7.8079254	.002100840
477	227529	108531333	21.8403297	7.8133892	.002096436
478	228484	109215352	21 8632111	7.8188456	.002092050
479	229441	109902239	21.8860686	7.8242942	.002087683
480	230400	110592000	21.9089023	7.8297353	.002083333
481	231361	111284641	21.9317122	7.8351688	.002079002
482	232324	111980168	21.9544984	7.8405949	.002074689
483	233289	112678587	21.9772610	7.8460134	.002070393
484	234256	113379904	22.0000000	7.8514244	.002066116
485	235225	114084125	22.0227155	7.8568281	.002061856
486	236196	114791256	22.0454077	7.8622242	.002057613
487	237169	115501303	22.0680765	7.8676130	.002053388
488	238144	116214272	22.0907220	7.8729944	.002049180
489	239121	116930169	22.1133444	7 8783684	.002044990
490	240100	117649000	22.1359436	7.8837352	.002040816
491	241081	118370771	22.1585198	7.8890946	.002036660
492	242064	119095488	22.1810730	7.8944468	.002032520
493	243049	119823157	22.2036033	7.8997917	.002028398
494	244036	120553784	22.2261108	7.9051294	.002024291
495	245025	121287375	22.2485955	7.9104599	.002020202
496	246016	122023936	22.2710575	7.9157832	.002016129

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
497	247009	122763473	22.2934968	7.9210994	.002012072
498	248004	123505992	22.3159136	7.9264085	.002008032
499	249001	124251499	22.3383079	7.9317104	.002004008
500	250000	125000000	22.3606798	7.9370053	.002000000
501	251001	125751501	22.3830293	7.9422931	.001996008
502	252004	126506008	22.4053565	7.9475739	.001992032
503	253009	127263527	22.4276615	7.9528477	.001988072
504	254016	128024064	22.4499443	7.9581144	.001984127
505	255025	128787625	22.4722051	7.9633743	.001980198
506	256036	129554216	22.4944438	7.9686271	.001976285
507	257049	130323843	22.5166605	7.9738731	.001972387
508	258064	131096512	22.5388553	7.9791122	.001968504
509	259081	131872229	22.5610283	7.9843444	.001964637
510	260100	132651000	22.5831796	7.9895697	.001960784
511	261121	133432831	22.6053091	7.9947883	.001956947
512	262144	134217728	22.6274170	8.0000000	.001953125
513	263169	135005697	22.6495033	8.0052049	.001949318
514	264196	135796744	22.6715681	8.0104032	.001945525
515	265225	136590875	22.6936114	8.0155946	.001941748
516	266256	137388096	22.7156334	8.0207794	.001937984
517	267289	138188413	22.7376340	8.0259574	.001934236
518	268324	138991832	22.7596134	8.0311287	.001930502
519	269361	139798359	22.7815715	8.0362935	.001926782
520	270400	140608000	22.8035085	8.0414515	.001923077
521	271441	141420761	22.8254244	8.0466030	.001919386
522	272484	142236648	22.8473193	8.0517479	.001915709
523	273529	143055667	22.8691933	8.0568862	.001912046
524	274576	143877824	22.8910463	8.0620180	.001908397
525	275625	144703125	22.9128785	8.0671432	.001904762
526	276676	145531576	22.9346899	8.0722620	.001901141
527	277729	146363183	22.9564806	8.0773743	.001897533
528	278784	147197952	22.9782506	8.0824800	.001893939
529	279841	148035889	23.0000000	8.0875794	.001890359
530	280900	148877000	23.0217289	8.0926723	.001886792
531	281961	149721291	23.0434372	8.0977589	.001883239
532	283024	150568768	23.0651252	8.1028390	.001879699
533	284089	151419437	23.0867928	8.1079128	.001876173
534	285156	152273304	23.1084400	8.1129803	.001872659
535	286225	153130375	23.1300670	8.1180414	.001869159
536	287296	153990656	23.1516738	8.1230962	.001865672
537	288369	154854153	23.1732605	8.1281447	.001862197
538	289444	155720872	23.1948270	8.1331870	.001858736
539	290521	156590819	23.2163735	8.1382230	.001855288
540	291600	157464000	23.2379001	8.1432529	.001851852
541	292681	158340421	23.2594067	8.1482765	.001848429
542	293764	159220088	23.2808935	8.1532939	.001845018
543	294849	160103007	23.3023604	8.1583051	.001841621
544	295936	160989184	23.3238076	8.1633102	.001838235
545	297025	161878625	23.3452351	8.1683092	.001834862
546	298116	162771336	23.3666429	8.1733020	.001831502
547	299209	163667323	23.3880311	8.1782888	.001828154
548	300304	164566592	23.4093998	8.1832695	.001824818
549	301401	165469149	23.4307490	8.1882441	.001821494
550	302500	166375000	23.4520788	8.1932127	.001818182
551	303601	167284151	23.4733892	8.1981753	.001814882
552	304704	168196608	23.4946802	8.2031319	.001811594
553	305809	169112377	23.5159520	8.2080825	.001808318
554	306916	170031464	23.5372046	8.2130271	.001805054
555	308025	170953875	23.5584380	8.2179657	.001801802
556	309136	171879616	23.5796522	8.2228985	.001798561
557	310249	172808693	23.6008474	8.2278254	.001795332
558	311364	173741112	23.6220236	8.2327463	.001792115

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
559	312481	174676879	23.6431808	8.2376614	.001788909
560	313600	175616000	23.6643191	8.2425706	.001785714
561	314721	176558481	23.6854386	8.2474740	.001782531
562	315844	177504328	23.7065392	8.2523715	001779359
563	316969	178453547	23.7276210	8.2572633	001776199
564	318096	179406144	23.7486842	8.2621492	.001773050
565	319225	180362125	23.7697286	8.2670294	.001769912
566	320356	181321496	23.7907545	8.2719039	.001766784
567	321489	182284263	23.8117618	8.2767726	.001763668
568	322624	183250432	23.8327506	8.2816355	.001760563
569	323761	184220000	23.8537209	8.2864928	.001757469
570	324900	185193000	23.8746728	8.2913444	.001754386
571	326041	186169411	23.8956063	8.2961903	.001751313
572	327184	187149248	23.9165215	8.3010304	.001748252
573	328329	188132517	23.9374184	8.3058651	.001745201
574	329476	189119224	23.9582971	8.3106941	.001742160
575	330625	190109375	23.9791576	8.3155175	.001739130
576	331776	191102976	24.0000000	8.3203353	.001736111
577	332929	192100033	24.0208243	8.3251475	.001733102
578	334084	193100552	24.0416306	8.3299542	.001730104
579	335241	194104539	24.0624188	8.3347553	.001727116
580	336400	195112000	24.0831891	8.3395509	.001724138
581	337561	196122941	24.1039416	8.3443410	.001721170
582	338724	197137368	24.1246762	8.3491256	.001718213
583	339889	198155287	24.1453929	8.3539047	.001715266
584	341056	199176704	24.1660919	8.3586784	.001712329
585	342225	200201625	24.1867732	8.3634466	.001709402
586	343396	201230056	24.2074369	8.3682095	.001706485
587	344569	202262003	24.2280829	8.3729668	.001703578
588	345744	203297472	24.2487113	8.3777188	.001700680
589	346921	204336469	24.2693222	8.3824653	.001697793
590	348100	205379000	24.2899156	8.3872065	.001694915
591	349281	206425071	24.3104916	8.3919423	.001692047
592	350464	207474688	24.3310501	8.3966729	.001689189
593	351649	208527857	24.3515913	8.4013981	.001686341
594	352836	209584584	24.3721152	8.4061180	.001683502
595	354025	210644875	24.3926218	8.4108326	001680672
596	355216	211708736	24.4131112	8.4155419	.001677852
597	356409	212776173	24.4335834	8.4202460	.001675042
598	357604	213847192	24.4540385	8.4249448	.001672241
599	358801	214921799	24.4744765	8.4296383	.001669449
600	360000	216000000	24.4948974	8.4343267	.001666667
601	361201	217081801	24.5153013	8.4390098	.001663894
602	362404	218167208	24.5356883	8.4436877	.001661130
603	363609	219256227	24.5560583	8.4483605	.001658375
604	364816	220348864	24.5764115	8.4530281	.001655629
605	366025	221445125	24.5967478	8.4576906	.001652893
606	367236	222545016	24.6170673	8.4623479	.001650165
607	368449	223648543	24.6373700	8.4670001	.001647446
608	369664	224755712	24.6576560	8.4716471	.001644737
609	370881	225866529	24.6779254	8.4762892	.001642036
610	372100	226981000	24.6981781	8.4809261	.001639344
611	373321	228099131	24.7184142	8.4855579	.001636661
612	374544	229220928	24.7386338	8.4901848	001633987
613	375769	230346397	24.7588368	8.4948065	001631321
614	376996	231475544	24.7790234	8.4994233	.001628664
615	378225	232608375	24.7991935	8.5040350	.001626016
616	379456	233744896	24.8193473	8.5086417	.001623377
617	380689	234885113	24.8394847	8.5132435	.001620746
618	381924	236029032	24.8596058	8.5178403	.001618123
619	383161	237176659	24.8797106	8.5224321	.001615509
620	384400	238328000	24.8997992	8.5270189	.001612903

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
621	385641	239483061	24.9198716	8.5316009	.001610306
622	386884	240641848	24.9399278	8.5361780	.001607717
623	388129	241804367	24.9599679	8.5407501	.001605136
624	389376	242970624	24.9799920	8.5453173	.001602564
625	390625	244140625	25.0000000	8.5498797	.001600000
626	391876	245314376	25.0199920	8.5544372	.001597444
627	393129	246491883	25.0399681	8.5589899	.001594896
628	394384	247673152	25.0599282	8.5635377	.001592357
629	395641	248858189	25.0798724	8.5680807	.001589825
630	396900	250047000	25.0998008	8.5726189	.001587302
631	398161	251239591	25.1197134	8.5771523	.001584786
632	399424	252435968	25.1396102	8.5816809	.001582278
633	400689	253636137	25.1594913	8.5862047	.001579779
634	401956	254840104	25.1793566	8.5907238	.001577287
635	403225	256047875	25.1992063	8.5952380	.001574803
636	404496	257259456	25.2190404	8.5997476	.001572327
637	405769	258474853	25.2388589	8.6042525	.001569859
638	407044	259694072	25.2586619	8.6087526	.001567398
639	408321	260917119	25.2784493	8.6132480	.001564945
640	409600	262144000	25.2982213	8.6177388	.001562500
641	410881	263374721	25.3179778	8.6222248	.001560062
642	412164	264609288	25.3377189	8.6267063	.001557632
643	413449	265847707	25.3574447	8.6311830	.001555210
644	414736	267089984	25.3771551	8.6356551	.001552795
645	416025	268336125	25.3968502	8.6401226	.001550388
646	417316	269586136	25.4165301	8.6445855	.001547988
647	418609	270840023	25.4361947	8.6490437	.001545595
648	419904	272097792	25.4558441	8.6534974	.001543210
649	421201	273359449	25.4754784	8.6579465	.001540832
650	422500	274625000	25.4950976	8.6623911	.001538462
651	423801	275894451	25.5147016	8.6668310	.001536098
652	425104	277167808	25.5342907	8.6712665	.001533742
653	426409	278445077	25.5538647	8.6756974	.001531394
654	427716	279726264	25.5734237	8.6801237	.001529052
655	429025	281011375	25.5929678	8.6845456	.001526718
656	430336	282300416	25.6124969	8.6889630	.001524390
657	431649	283593393	25.6320112	8.6933759	.001522070
658	432964	284890312	25.6515107	8.6977843	.001519757
659	434281	286191179	25.6709953	8.7021882	.001517451
660	435600	287496000	25.6904652	8.7065877	.001515152
661	436921	288804781	25.7099203	8.7109827	.001512859
662	438244	290117528	25.7293607	8.7153734	.001510574
663	439569	291434247	25.7487864	8.7197596	.001508296
664	440896	292754944	25.7681975	8.7241414	.001506024
665	442225	294079625	25.7875939	8.7285187	.001503759
666	443556	295408296	25.8069758	8.7328918	.001501502
667	444889	296740963	25.8263431	8.7372604	.001499250
668	446224	298077632	25.8456960	8.7416246	.001497006
669	447561	299418309	25.8650343	8.7459846	.001494768
670	448900	300763000	25.8843582	8.7503401	.001492537
671	450241	302111711	25.9036677	8.7546913	.001490313
672	451584	303464448	25.9229628	8.7590383	.001488095
673	452929	304821217	25.9422435	8.7633809	.001485884
674	454276	306182024	25.9615100	8.7677192	.001483680
675	455625	307546875	25.9807621	8.7720532	.001481481
676	456976	308915776	26.0000000	8.7763830	.001479290
677	458329	310288733	26.0192237	8.7807084	.001477105
678	459684	311665752	26.0384331	8.7850296	.001474926
679	461041	313046839	26.0576284	8.7893466	.001472754
680	462400	314432000	26.0768096	8.7936593	.001470588
681	463761	315821241	26.0959767	8.7979679	.001468429
682	465124	317214568	26.1151297	8.8022721	.001466276

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
683	466489	318611987	26.1342687	8.8065722	.001464129
684	467856	320013504	26.1533937	8.8108681	.001461988
685	469225	321419125	26.1725047	8.8151598	.001459854
686	470596	322828856	26.1916017	8.8194474	.001457726
687	471969	324242703	26.2106848	8.8237307	.001455604
688	473344	325660672	26.2297541	8.8280099	.001453488
689	474721	327082769	26.2488095	8.8322850	.001451379
690	476100	328509000	26.2678511	8.8365559	.001449275
691	477481	329939371	26.2868789	8.8408227	.001447178
692	478864	331373888	26.3058929	8.8450854	.001445087
693	480249	332812557	26.3248932	8.8493440	.001443001
694	481636	334255384	26.3438797	8.8535985	.001440922
695	483025	335702375	26.3628527	8.8578489	.001438849
696	484416	337153536	26.3818119	8.8620952	.001436782
697	485809	338608873	26.4007576	8.8663375	.001434720
698	487204	340068392	26.4196896	8.8705757	.001432665
699	488601	341532099	26.4386081	8.8748099	.001430615
700	490000	343000000	26.4575131	8.8790400	.001428571
701	491401	344472101	26.4764046	8.8832661	.001426534
702	492804	345948408	26.4952826	8.8874882	.001424501
703	494209	347428927	26.5141472	8.8917063	.001422475
704	495616	348913664	26.5329983	8.8959204	.001420455
705	497025	350402625	26.5518361	8.9001304	.001418440
706	498436	351895816	26.5706605	8.9043366	.001416431
707	499849	353393243	26.5894716	8.9085387	.001414427
708	501264	354894912	26.6082694	8.9127369	.001412429
709	502681	356400829	26 6270539	8.9169311	.001410437
710	504100	357911000	26.6458252	8.9211214	.001408451
711	505521	359425431	26.6645833	8.9253078	.001406470
712	506944	360944128	26.6833281	8.9294902	.001404494
713	508369	362467097	26.7020598	8.9336687	.001402525
714	509796	363994344	26.7207784	8.9378433	.001400560
715	511225	365525875	26.7394839	8.9420140	.001398601
716	512656	367061696	26.7581763	8.9461809	.001396648
717	514089	368601813	26.7768557	8.9503438	.001394700
718	515524	370146232	26.7955220	8.9545029	.001392758
719	516961	371694959	26.8141754	8.9586581	.001390821
720	518400	373248000	26.8328157	8.9628095	.001388889
721	519841	374805361	26.8514432	8.9669570	.001386963
722	521284	376367048	26.8700577	8.9711007	.001385042
723	522729	377933067	26.8886593	8.9752406	.001383126
724	524176	379503424	26.9072481	8.9793766	.001381215
725	525625	381078125	26.9258240	8.9835089	.001379310
726	527076	382657176	26.9443872	8.9876373	.001377410
727	528529	384240583	26.9629375	8.9917620	.001375516
728	529984	385828352	26.9814751	8.9958829	.001373626
729	531441	387420489	27.0000000	9.0000000	.001371742
730	532900	389017000	27.0185122	9.0041134	.001369863
731	534361	390617891	27.0370117	9.0082229	.001367989
732	535824	392223168	27.0554985	9.0123288	.001366120
733	537289	393832837	27.0739727	9.0164309	.001364256
734	538756	395446904	27.0924344	9.0205293	.001362398
735	540225	397065375	27.1108834	9.0246239	.001360544
736	541696	398688256	27.1293199	9.0287149	.001358696
737	543169	400315553	27.1477439	9.0328021	.001356852
738	544644	401947272	27.1661554	9.0368857	.001355014
739	546121	403583419	27.1845544	9.0409655	.001353180
740	547600	405224000	27.2029410	9.0450419	.001351351
741	549081	406869021	27.2213152	9.0491142	.001349528
742	550564	408518488	27.2396769	9.0531831	.001347709
743	552049	410172407	27.2580263	9.0572482	.001345895
744	553536	411830784	27.2763634	9.0613098	.001344086

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
745	555025	413493625	27.2946881	9.0653677	.001342282
746	556516	415160936	27.3130006	9.0694220	.001340483
747	558009	416832723	27.3313007	9.0734726	.001338688
748	559504	418508992	27.3495887	9.0775197	.001336898
749	561001	420189749	27.3678644	9.0815631	.001335113
750	562500	421875000	27.3861279	9.0856030	.001333333
751	564001	423564751	27.4043792	9.0896392	.001331558
752	565504	425259008	27.4226184	9.0936719	.001329787
753	567009	426957777	27.4408455	9.0977010	.001328021
754	568516	428661064	27.4590604	9.1017265	.001326260
755	570025	430368875	27.4772633	9.1057485	.001324503
756	571536	432081216	27.4954542	9.1097669	.001322751
757	573049	433798093	27.5136330	9.1137818	.001321004
758	574564	435519512	27.5317998	9.1177931	.001319261
759	576081	437245479	27.5499546	9.1218010	.001317523
760	577600	438976000	27.5680975	9.1258053	.001315789
761	579121	440711081	27.5862284	9.1298061	.001314060
762	580644	442450728	27.6043475	9.1338034	.001312336
763	582169	444194947	27.6224546	9.1377971	.001310616
764	583696	445943744	27.6405499	9.1417874	.001308901
765	585225	447697125	27.6586334	9.1457742	.001307190
766	586756	449455096	27.6767050	9.1497576	.001305483
767	588289	451217663	27.6947648	9.1537375	.001303781
768	589824	452984832	27.7128129	9.1577139	.001302083
769	591361	454756609	27.7308492	9.1616869	.001300390
770	592900	456533000	27.7488739	9.1656565	.001298701
771	594441	458314011	27.7668868	9.1696225	.001297017
772	595984	460099648	27.7848880	9.1735852	.001295337
773	597529	461889917	27.8028775	9.1775445	.001293661
774	599076	463684824	27.8208555	9.1815003	.001291990
775	600625	465484375	27.8388218	9.1854527	.001290323
776	602176	467288576	27.8567766	9.1894018	.001288660
777	603729	469097433	27.8747197	9.1933474	.001287001
778	605284	470910952	27.8926514	9.1972897	.001285347
779	606841	472729139	27.9105715	9.2012286	.001283697
780	608400	474552000	27.9284801	9.2051641	.001282051
781	609961	476379541	27.9463772	9.2090962	.001280410
782	611524	478211768	27.9642629	9.2130250	.001278772
783	613089	480048687	27.9821372	9.2169505	.001277139
784	614656	481890304	28.0000000	9.2208726	.001275510
785	616225	483736625	28.0178515	9.2247914	.001273885
786	617796	485587656	28.0356915	9.2287068	.001272265
787	619369	487443403	28.0535203	9.2326189	.001270648
788	620944	489303872	28.0713377	9.2365277	.001269036
789	622521	491169069	28.0891438	9.2404333	.001267427
790	624100	493039000	28.1069386	9.2443355	.001265823
791	625681	494913671	28.1247222	9.2482344	.001264223
792	627264	496793088	28.1424946	9.2521300	.001262626
793	628849	498677257	28.1602557	9.2560224	.001261034
794	630436	500566184	28.1780056	9.2599114	.001259446
795	632025	502459875	28.1957444	9.2637973	.001257862
796	633616	504358336	28.2134720	9.2676798	.001256281
797	635209	506261573	28.2311884	9.2715592	.001254705
798	636804	508169592	28.2488938	9.2754352	.001253133
799	638401	510082399	28.2665881	9.2793081	.001251564
800	640000	512000000	28.2842712	9.2831777	.001250000
801	641601	513922401	28.3019434	9.2870440	.001248439
802	643204	515849608	28.3196045	9.2909072	.001246883
803	644809	517781627	28.3372546	9.2947671	.001245330
804	646416	519718464	28.3548938	9.2986239	.001243781
805	648025	521660125	28.3725219	9.3024775	.001242236
806	649636	523606616	28.3901391	9.3063278	.001240695

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
807	651249	525557943	28.4077454	9.3101750	.001239157
808	652864	527514112	28.4253408	9.3140190	.001237624
809	654481	529475129	28.4429253	9.3178599	.001236094
810	656100	531441000	28.4604989	9.3216975	.001234568
811	657721	533411731	28.4780617	9.3255320	.001233046
812	659344	535387328	28.4956137	9.3293634	.001231527
813	660969	537367797	28.5131549	9.3331916	.001230012
814	662596	539353144	28.5306852	9.3370167	.001228501
815	664225	541343375	28.5482048	9.3408386	.001226994
816	665856	543338496	28.5657137	9.3446575	.001225490
817	667489	545338513	28.5832119	9.3484731	.001223990
818	669124	547343432	28.6006993	9.3522857	.001222494
819	670761	549353259	28.6181760	9.3560952	.001221001
820	672400	551368000	28.6356421	9.3599016	.001219512
821	674041	553387661	28.6530976	9.3637049	.001218027
822	675684	555412248	28.6705424	9.3675051	.001216545
823	677329	557441767	28.6879766	9.3713022	.001215067
824	678976	559476224	28.7054002	9.3750963	.001213592
825	680625	561515625	28.7228132	9.3788873	.001212121
826	682276	563559976	28.7402157	9.3826752	.001210654
827	683929	565609283	28.7576077	9.3864600	.001209190
828	685584	567663552	28.7749891	9.3902419	.001207729
829	687241	569722789	28.7923601	9.3940206	.001206273
830	688900	571787000	28.8097206	9.3977964	.001204819
831	690561	573856191	28.8270706	9.4015691	.001203369
832	692224	575930368	28.8444102	9.4053387	.001201923
833	693889	578009537	28.8617394	9.4091054	.001200480
834	695556	580093704	28.8790582	9.4128690	.001199041
835	697225	582182875	28.8963666	9.4166297	.001197605
836	698896	584277056	28.9136646	9.4203873	.001196172
837	700569	586376253	28.9309523	9.4241420	.001194743
838	702244	588480472	28.9482297	9.4278936	.001193317
839	703921	590589719	28.9654967	9.4316423	.001191895
840	705600	592704000	28.9827535	9.4353880	.001190476
841	707281	594823321	29.0000000	9.4391307	.001189061
842	708964	596947688	29.0172363	9.4428704	.001187648
843	710649	599077107	29.0344623	9.4466072	.001186240
844	712336	601211584	29.0516781	9.4503410	.001184834
845	714025	603351125	29.0688837	9.4540719	.001183432
846	715716	605495736	29.0860791	9.4577999	.001182033
847	717409	607645423	29.1032644	9.4615249	.001180638
848	719104	609800192	29.1204396	9.4652470	.001179245
849	720801	611960049	29.1376046	9.4689661	.001177856
850	722500	614125000	29.1547595	9.4726824	.001176471
851	724201	616295051	29.1719043	9.4763957	.001175088
852	725904	618470208	29.1890390	9.4801061	.001173709
853	727609	620650477	29.2061637	9.4838136	.001172333
854	729316	622835864	29.2232784	9.4875182	.001170960
855	731025	625026375	29.2403830	9.4912200	.001169591
856	732736	627222016	29.2574777	9.4949188	.001168224
857	734449	629422793	29.2745623	9.4986147	.001166861
858	736164	631628712	29.2916370	9.5023078	.001165501
859	737881	633839779	29.3087018	9.5059980	.001164144
860	739600	636056000	29.3257566	9.5096854	.001162791
861	741321	638277381	29.3428015	9.5133699	.001161440
862	743044	640503928	29.3598365	9.5170515	.001160093
863	744769	642735647	29.3768616	9.5207303	.001158749
864	746496	644972544	29.3938769	9.5244063	.001157407
865	748225	647214625	29.4108823	9.5280794	.001156069
866	749956	649461896	29.4278779	9.5317497	.001154734
867	751689	651714363	29.4448637	9.5354172	.001153403
868	753424	653972032	29.4618397	9.5390818	.001152074

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
869	755161	656234909	29.4788059	9.5427437	.001150748
870	756900	658503000	29.4957624	9.5464027	.001149425
871	758641	660776311	29.5127091	9.5500589	.001148106
872	760384	663054848	29.5296461	9.5537123	.001146789
873	762129	665338617	29.5465734	9.5573630	.001145475
874	763876	667627624	29.5634910	9.5610108	.001144165
875	765625	669921875	29.5803989	9.5646559	.001142857
876	767376	672221376	29.5972972	9.5682982	.001141553
877	769129	674526133	29.6141858	9.5719377	.001140251
878	770884	676836152	29.6310648	9.5755745	.001138952
879	772641	679151439	29.6479342	9.5792085	.001137656
880	774400	681472000	29.6647939	9.5828397	.001136364
881	776161	683797841	29.6816442	9.5864682	.001135074
882	777924	686128968	29.6984848	9.5900939	.001133787
883	779689	688465387	29.7153159	9.5937169	.001132503
884	781456	690807104	29.7321375	9.5973373	.001131222
885	783225	693154125	29.7489496	9.6009548	.001129944
886	784996	695506456	29.7657521	9.6045696	.001128668
887	786769	697864103	29.7825452	9.6081817	.001127396
888	788544	700227072	29.7993289	9.6117911	.001126126
889	790321	702595369	29.8161030	9.6153977	.001124859
890	792100	704969000	29.8328678	9.6190017	.001123596
891	793881	707347971	29.8496231	9.6226030	.001122334
892	795664	709732288	29.8663690	9.6262016	.001121076
893	797449	712121957	29.8831056	9.6297975	.001119821
894	799236	714516984	29.8998328	9.6333907	.001118568
895	801025	716917375	29.9165506	9.6369812	.001117318
896	802816	719323136	29.9332591	9.6405690	.001116071
897	804609	721734273	29.9499583	9.6441542	.001114827
898	806404	724150792	29.9666481	9.6477367	.001113586
899	808201	726572699	29.9833287	9.6513166	.001112347
900	810000	729000000	30.0000000	9.6548938	.001111111
901	811801	731432701	30.0166620	9.6584684	.001109878
902	813604	733870808	30.0333148	9.6620403	.001108647
903	815409	736314327	30.0499584	9.6656096	.001107420
904	817216	738763264	30.0665928	9.6691762	.001106195
905	819025	741217625	30.0832179	9.6727403	.001104972
906	820836	743677416	30.0998339	9.6763017	.001103753
907	822649	746142643	30.1164407	9.6798604	.001102536
908	824464	748613312	30.1330383	9.6834166	.001101322
909	826281	751089429	30.1496269	9.6869701	.001100110
910	828100	753571000	30.1662063	9.6905211	.001098901
911	829921	756058031	30.1827765	9.6940694	.001097695
912	831744	758550528	30.1993377	9.6976151	.001096491
913	833569	761048497	30.2158899	9.7011583	.001095290
914	835396	763551944	30.2324329	9.7046989	.001094092
915	837225	766060875	30.2489669	9.7082369	.001092896
916	839056	768575296	30.2654919	9.7117723	.001091703
917	840889	771095213	30.2820079	9.7153051	.001090513
918	842724	773620632	30.2985148	9.7188354	.001089325
919	844561	776151559	30.3150128	9.7223631	.001088139
920	846400	778688000	30.3315018	9.7258883	.001086957
921	848241	781229961	30.3479818	9.7294109	.001085776
922	850084	783777448	30.3644529	9.7329309	.001084599
923	851929	786330467	30.3809151	9.7364484	.001083423
924	853776	788889024	30.3973683	9.7399634	.001082251
925	855625	791453125	30.4138127	9.7434758	.001081081
926	857476	794022776	30.4302481	9.7469857	.001079914
927	859329	796597983	30.4466747	9.7504930	.001078749
928	861184	799178752	30.4630924	9.7539979	.001077586
929	863041	801765089	30.4795013	9.7575002	.001076426
930	864900	804357000	30.4959014	9.7610001	.001075269

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
931	866761	806954491	30.5122926	9.7644974	.001074114
932	868624	809557568	30.5286750	9.7679922	.001072961
933	870489	812166237	30.5450487	9.7714845	.001071811
934	872356	814780504	30.5614136	9.7749743	.001070664
935	874225	817400375	30.5777697	9.7784616	.001069519
936	876096	820025856	30.5941171	9.7819466	.001068376
937	877969	822656953	30.6104557	9.7854288	.001067236
938	879844	825293672	30.6267857	9.7889087	.001066098
939	881721	827936019	30.6431069	9.7923861	.001064963
940	883600	830584000	30.6594194	9.7958611	.001063830
941	885481	833237621	30.6757233	9.7993336	.001062699
942	887364	835896888	30.6920185	9.8028036	.001061571
943	889249	838561807	30.7083051	9.8062711	.001060445
944	891136	841232384	30.7245830	9.8097362	.001059322
945	893025	843908625	30.7408523	9.8131989	.001058201
946	894916	846590536	30.7571130	9.8166591	.001057082
947	896809	849278123	30.7733651	9.8201169	.001055966
948	898704	851971392	30.7896086	9.8235723	.001054852
949	900601	854670349	30.8058436	9.8270252	.001053741
950	902500	857375000	30.8220700	9.8304757	.001052632
951	904401	860085351	30.8382879	9.8339238	.001051525
952	906304	862801408	30.8544972	9.8373695	.001050420
953	908209	865523177	30.8706981	9.8408127	.001049318
954	910116	868250664	30.8868904	9.8442536	.001048218
955	912025	870983875	30.9030743	9.8476920	.001047120
956	913936	873722816	30.9192497	9.8511280	.001046025
957	915849	876467493	30.9354166	9.8545617	.001044932
958	917764	879217912	30.9515751	9.8579929	.001043841
959	919681	881974079	30.9677251	9.8614218	.001042753
960	921600	884736000	30.9838668	9.8648483	.001041667
961	923521	887503681	31.0000000	9.8682724	.001040583
962	925444	890277128	31.0161248	9.8716941	.001039501
963	927369	893056347	31.0322413	9.8751135	.001038422
964	929296	895841344	31.0483494	9.8785305	.001037344
965	931225	898632125	31.0644491	9.8819451	.001036269
966	933156	901428696	31.0805405	9.8853574	.001035197
967	935089	904231063	31.0966236	9.8887673	.001034126
968	937024	907039232	31.1126984	9.8921749	.001033058
969	938961	909853209	31.1287648	9.8955801	.001031992
970	940900	912673000	31.1448230	9.8989830	.001030928
971	942841	915498611	31.1608729	9.9023835	.001029866
972	944784	918330048	31.1769145	9.9057817	.001028807
973	946729	921167317	31.1929479	9.9091776	.001027749
974	948676	924010424	31.2089731	9.9125712	.001026694
975	950625	926859375	31.2249900	9.9159624	.001025641
976	952576	929714176	31.2409987	9.9193513	.001024590
977	954529	932574833	31.2569992	9.9227379	.001023541
978	956484	935441352	31.2729915	9.9261222	.001022495
979	958441	938313739	31.2889757	9.9295042	.001021450
980	960400	941192000	31.3049517	9.9328839	.001020408
981	962361	944076141	31.3209195	9.9362613	.001019368
982	964324	946966168	31.3368792	9.9396363	.001018330
983	966289	949862087	31.3528308	9.9430092	.001017294
984	968256	952763904	31.3687743	9.9463797	.001016260
985	970225	955671625	31.3847097	9.9497479	.001015228
986	972196	958585256	31.4006369	9.9531138	.001014199
987	974169	961504803	31.4165561	9.9564775	.001013171
988	976144	964430272	31.4324673	9.9598389	.001012146
989	978121	967361669	31.4483704	9.9631981	.001011122
990	980100	970299000	31.4642654	9.9665549	.001010101
991	982081	973242271	31.4801525	9.9699095	.001009082
992	984064	976191488	31.4960315	9.9732619	.001008065

No.	Squares.	Cubes.	Square Roots.	Cube Roots.	Reciprocals.
993	986049	979146657	31.5119025	9.9766120	.001007049
994	988036	982107784	31.5277655	9.9799599	.001006036
995	990025	985074875	31.5436206	9.9833055	.001005025
996	992016	988047936	31.5594677	9.9866488	.001004016
997	994009	991026973	31.5753068	9.9899900	.001003009
998	996004	994011992	31.5911380	9.9933289	.001002004
999	998001	997002999	31.6069613	9.9966656	.001001001
1000	1000000	1000000000	31.6227766	10.0000000	.001000000
1001	1002001	1003003001	31.6385840	10.0033322	.0009990010
1002	1004004	1006012008	31.6543836	10.0066622	.0009980040
1003	1006009	1009027027	31.6701752	10.0099899	.0009970090
1004	1008016	1012048064	31.6859590	10.0133155	.0009960159
1005	1010025	1015075125	31.7017349	10.0166389	.0009950249
1006	1012036	1018108216	31.7175030	10.0199601	.0009940358
1007	1014049	1021147343	31.7332633	10.0232791	.0009930487
1008	1016064	1024192512	31.7490157	10.0265958	.0009920635
1009	1018081	1027243729	31.7647603	10.0299104	.0009910803
1010	1020100	1030301000	31.7804972	10.0332228	.0009900990
1011	1022121	1033364331	31.7962262	10.0365330	.0009891197
1012	1024144	1036433728	31.8119474	10.0398410	.0009881423
1013	1026169	1039509197	31.8276609	10.0431469	.0009871668
1014	1028196	1042590744	31.8433666	10.0464506	.0009861933
1015	1030225	1045678375	31.8590646	10.0497521	.0009852217
1016	1032256	1048772096	31.8747549	10.0530514	.0009842520
1017	1034289	1051871913	31.8904374	10.0563485	.0009832842
1018	1036324	1054977832	31.9061123	10.0596435	.0009823183
1019	1038361	1058089859	31.9217794	10.0629364	.0009813543
1020	1040400	1061208000	31.9374388	10.0662271	.0009803922
1021	1042441	1064332261	31.9530906	10.0695156	.0009794319
1022	1044484	1067462648	31.9687347	10.0728020	.0009784736
1023	1046529	1070599167	31.9843712	10.0760863	.0009775171
1024	1048576	1073741824	32.0000000	10.0793684	.0009765625
1025	1050625	1076890625	32.0156212	10.0826484	.0009756098
1026	1052676	1080045576	32.0312348	10.0859262	.0009746589
1027	1054729	1083206683	32.0468407	10.0892019	.0009737098
1028	1056784	1086373952	32.0624391	10.0924755	.0009727626
1029	1058841	1089547389	32.0780298	10.0957469	.0009718173
1030	1060900	1092727000	32.0936131	10.0990163	.0009708738
1031	1062961	1095912791	32.1091887	10.1022835	.0009699321
1032	1065024	1099104768	32.1247568	10.1055487	.00 9689922
1033	1067089	1102302937	32.1403173	10.1088117	.0009680542
1034	1069156	1105507304	32.1558704	10.1120726	.0009671180
1035	1071225	1108717875	32.1714159	10.1153314	.0009661836
1036	1073296	1111934656	32.1869539	10.1185882	.0009652510
1037	1075369	1115157653	32.2024844	10.1218428	.0009643202
1038	1077444	1118386872	32.2180074	10.1250953	.0009633911
1039	1079521	1121622319	32.2335229	10.1283457	.0009624639
1040	1081600	1124864000	32.2490310	10.1315941	.0009615385
1041	1083681	1128111921	32.2645316	10.1348403	.0009606148
1042	1085764	1131366088	32.2800248	10.1380845	.0009596929
1043	1087849	1134626507	32.2955105	10.1413266	.0009587738
1044	1089936	1137893184	32.3109888	10.1445667	.0009578544
1045	1092025	1141166125	32.3264598	10.1478047	.0009569378
1046	1094116	1144445336	32.3419233	10.1510406	.0009560229
1047	1096209	1147730823	32.3573794	10.1542744	.0009551098
1048	1098304	1151022592	32.3728281	10.1575062	.0009541985
1049	1100401	1154320649	32.3882695	10.1607359	.0009532888
1050	1102500	1157625000	32.4037035	10.1639636	.0009523810
1051	1104601	1160935651	32.4191301	10.1671893	.0009514748
1052	1106704	1164252608	32.4345495	10.1704129	.0009505703
1053	1108809	1167575877	32.4499615	10.1736344	.0009496676
1054	1110916	1170905464	32.4653662	10.1768539	.0009487666

No. 100 L. 000.] No. 109 L. 040.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
100	000000	0434	0868	1301	1734	2166	2598	3029	3461	3891	432
1	4321	4751	5181	5609	6038	6466	6894	7321	7748	8174	428
2	8600	9026	9451	9876	0300	0724	1147	1570	1993	2415	424
3	012837	3259	3680	4100	4521	4940	5360	5779	6197	6616	420
4	7033	7451	7868	8284	8700	9116	9532	9947	0361	0775	416
5	021189	1603	2016	2428	2841	3252	3664	4075	4486	4896	412
6	5306	5715	6125	6533	6942	7350	7757	8164	8571	8978	408
7	9384	9789	0195	0600	1004	1408	1812	2216	2619	3021	404
8	033424	3826	4227	4628	5029	5430	5830	6230	6629	7028	400
9	7426	7825	8223	8620	9017	9414	9811	0207	0602	0998	397
	04										

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
434	43.4	86.8	130.2	173.6	217.0	260.4	303.8	347.2	390.6
433	43.3	86.6	129.9	173.2	216.5	259.8	303.1	346.4	389.7
432	43.2	86.4	129.6	172.8	216.0	259.2	302.4	345.6	388.8
431	43.1	86.2	129.3	172.4	215.5	258.6	301.7	344.8	387.9
430	43.0	86.0	129.0	172.0	215.0	258.0	301.0	344.0	387.0
429	42.9	85.8	128.7	171.6	214.5	257.4	300.3	343.2	386.1
428	42.8	85.6	128.4	171.2	214.0	256.8	299.6	342.4	385.2
427	42.7	85.4	128.1	170.8	213.5	256.2	298.9	341.6	384.3
426	42.6	85.2	127.8	170.4	213.0	255.6	298.2	340.8	383.4
425	42.5	85.0	127.5	170.0	212.5	255.0	297.5	340.0	382.5
424	42.4	84.8	127.2	169.6	212.0	254.4	296.8	339.2	381.6
423	42.3	84.6	126.9	169.2	211.5	253.8	296.1	338.4	380.7
422	42.2	84.4	126.6	168.8	211.0	253.2	295.4	337.6	379.8
421	42.1	84.2	126.3	168.4	210.5	252.6	294.7	336.8	378.9
420	42.0	84.0	126.0	168.0	210.0	252.0	294.0	336.0	378.0
419	41.9	83.8	125.7	167.6	209.5	251.4	293.3	335.2	377.1
418	41.8	83.6	125.4	167.2	209.0	250.8	292.6	334.4	376.2
417	41.7	83.4	125.1	166.8	208.5	250.2	291.9	333.6	375.3
416	41.6	83.2	124.8	166.4	208.0	249.6	291.2	332.8	374.4
415	41.5	83.0	124.5	166.0	207.5	249.0	290.5	332.0	373.5
414	41.4	82.8	124.2	165.6	207.0	248.4	289.8	331.2	372.6
413	41.3	82.6	123.9	165.2	206.5	247.8	289.1	330.4	371.7
412	41.2	82.4	123.6	164.8	206.0	247.2	288.4	329.6	370.8
411	41.1	82.2	123.3	164.4	205.5	246.6	287.7	328.8	369.9
410	41.0	82.0	123.0	164.0	205.0	246.0	287.0	328.0	369.0
409	40.9	81.8	122.7	163.6	204.5	245.4	286.3	327.2	368.1
408	40.8	81.6	122.4	163.2	204.0	244.8	285.6	326.4	367.2
407	40.7	81.4	122.1	162.8	203.5	244.2	284.9	325.6	366.3
406	40.6	81.2	121.8	162.4	203.0	243.6	284.2	324.8	365.4
405	40.5	81.0	121.5	162.0	202.5	243.0	283.5	324.0	364.5
404	40.4	80.8	121.2	161.6	202.0	242.4	282.8	323.2	363.6
403	40.3	80.6	120.9	161.2	201.5	241.8	282.1	322.4	362.7
402	40.2	80.4	120.6	160.8	201.0	241.2	281.4	321.6	361.8
401	40.1	80.2	120.3	160.4	200.5	240.6	280.7	320.8	360.9
400	40.0	80.0	120.0	160.0	200.0	240.0	280.0	320.0	360.0
399	39.9	79.8	119.7	159.6	199.5	239.4	279.3	319.2	359.1
398	39.8	79.6	119.4	159.2	199.0	238.8	278.6	318.4	358.2
397	39.7	79.4	119.1	158.8	198.5	238.2	277.9	317.6	357.3
396	39.6	79.2	118.8	158.4	198.0	237.6	277.2	316.8	356.4
395	39.5	79.0	118.5	158.0	197.5	237.0	276.5	316.0	355.5

No. 110 L. 041.] [No. 119 L. 078.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
110	041393	1787	2182	2576	2969	3362	3755	4148	4540	4932	393
1	5323	5714	6105	6495	6885	7275	7664	8053	8442	8830	390
2	9218	9606	9993	0380	0766	1153	1538	1924	2309	2694	386
3	053078	3463	3846	4230	4613	4996	5378	5760	6142	6524	383
4	6905	7286	7666	8046	8426	8805	9185	9563	9942	0320	379
5	060698	1075	1452	1829	2206	2582	2958	3333	3709	4083	376
6	4458	4832	5206	5580	5953	6326	6699	7071	7443	7815	373
7	8186	8557	8928	9298	9668	0038	0407	0776	1145	1514	370
8	071882	2250	2617	2985	3352	3718	4085	4451	4816	5182	366
9	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	363

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
395	39.5	79.0	118.5	158.0	197.5	237.0	276.5	316.0	355.5
394	39.4	78.8	118.2	157.6	197.0	236.4	275.8	315.2	354.6
393	39.3	78.6	117.9	157.2	196.5	235.8	275.1	314.4	353.7
392	39.2	78.4	117.6	156.8	196.0	235.2	274.4	313.6	352.8
391	39.1	78.2	117.3	156.4	195.5	234.6	273.7	312.8	351.9
390	39.0	78.0	117.0	156.0	195.0	234.0	273.0	312.0	351.0
389	38.9	77.8	116.7	155.6	194.5	233.4	272.3	311.2	350.1
388	38.8	77.6	116.4	155.2	194.0	232.8	271.6	310.4	349.2
387	38.7	77.4	116.1	154.8	193.5	232.2	270.9	309.6	348.3
386	38.6	77.2	115.8	154.4	193.0	231.6	270.2	308.8	347.4
385	38.5	77.0	115.5	154.0	192.5	231.0	269.5	308.0	346.5
384	38.4	76.8	115.2	153.6	192.0	230.4	268.8	307.2	345.6
383	38.3	76.6	114.9	153.2	191.5	229.8	268.1	306.4	344.7
382	38.2	76.4	114.6	152.8	191.0	229.2	267.4	305.6	343.8
381	38.1	76.2	114.3	152.4	190.5	228.6	266.7	304.8	342.9
380	38.0	76.0	114.0	152.0	190.0	228.0	266.0	304.0	342.0
379	37.9	75.8	113.7	151.6	189.5	227.4	265.3	303.2	341.1
378	37.8	75.6	113.4	151.2	189.0	226.8	264.6	302.4	340.2
377	37.7	75.4	113.1	150.8	188.5	226.2	263.9	301.6	339.3
376	37.6	75.2	112.8	150.4	188.0	225.6	263.2	300.8	338.4
375	37.5	75.0	112.5	150.0	187.5	225.0	262.5	300.0	337.5
374	37.4	74.8	112.2	149.6	187.0	224.4	261.8	299.2	336.6
373	37.3	74.6	111.9	149.2	186.5	223.8	261.1	298.4	335.7
372	37.2	74.4	111.6	148.8	186.0	223.2	260.4	297.6	334.8
371	37.1	74.2	111.3	148.4	185.5	222.6	259.7	296.8	333.9
370	37.0	74.0	111.0	148.0	185.0	222.0	259.0	296.0	333.0
369	36.9	73.8	110.7	147.6	184.5	221.4	258.3	295.2	332.1
368	36.8	73.6	110.4	147.2	184.0	220.8	257.6	294.4	331.2
367	36.7	73.4	110.1	146.8	183.5	220.2	256.9	293.6	330.3
366	36.6	73.2	109.8	146.4	183.0	219.6	256.2	292.8	329.4
365	36.5	73.0	109.5	146.0	182.5	219.0	255.7	292.0	328.5
364	36.4	72.8	109.2	145.6	182.0	218.4	254.8	291.2	327.6
363	36.3	72.6	108.9	145.2	181.5	217.8	254.1	290.4	326.7
362	36.2	72.4	108.6	144.8	181.0	217.2	253.4	289.6	325.8
361	36.1	72.2	108.3	144.4	180.5	216.6	252.7	288.8	324.9
360	36.0	72.0	108.0	144.0	180.0	216.0	252.0	288.0	324.0
359	35.9	71.8	107.7	143.6	179.5	215.4	251.3	287.2	323.1
358	35.8	71.6	107.4	143.2	179.0	214.8	250.6	286.4	322.2
357	35.7	71.4	107.1	142.8	178.5	214.2	249.9	285.6	321.3
356	35.6	71.2	106.8	142.4	178.0	213.6	249.2	284.8	320.4

No. 120 L. 079.] [No. 134 L. 130.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
120	079181	9543	9904	0266	0626	0987	1347	1707	2067	2426	360
1	082785	3144	3503	3861	4219	4576	4934	5291	5647	6004	357
2	6360	6716	7071	7426	7781	8136	8490	8845	9198	9552	355
3	9905	0258	0611	0963	1315	1667	2018	2370	2721	3071	352
4	093422	3772	4122	4471	4820	5169	5518	5866	6215	6562	349
5	6910	7257	7604	7951	8298	8644	8990	9335	9681	0026	346
6	100371	0715	1059	1403	1747	2091	2434	2777	3119	3462	343
7	3804	4146	4487	4828	5169	5510	5851	6191	6531	6871	341
8	7210	7549	7888	8227	8565	8903	9241	9579	9916	0253	338
9	110590	0926	1263	1599	1934	2270	2605	2940	3275	3609	335
130	3943	4277	4611	4944	5278	5611	5943	6276	6608	6940	333
1	7271	7603	7934	8265	8595	8926	9256	9586	9915	0245	330
2	120574	0903	1231	1560	1888	2216	2544	2871	3198	3525	328
3	3852	4178	4504	4830	5156	5481	5806	6131	6456	6781	325
4	7105	7429	7753	8076	8399	8722	9045	9368	9690	0012	323
	13										

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
355	35.5	71.0	106.5	142.0	177.5	213.0	248.5	284.0	319.5
354	35.4	70.8	106.2	141.6	177.0	212.4	247.8	283.2	318.6
353	35.3	70.6	105.9	141.2	176.5	211.8	247.1	282.4	317.7
352	35.2	70.4	105.6	140.8	176.0	211.2	246.4	281.6	316.8
351	35.1	70.2	105.3	140.4	175.5	210.6	245.7	280.8	315.9
350	35.0	70.0	105.0	140.0	175.0	210.0	245.0	280.0	315.0
349	34.9	69.8	104.7	139.6	174.5	209.4	244.3	279.2	314.1
348	34.8	69.6	104.4	139.2	174.0	208.8	243.6	278.4	313.2
347	34.7	69.4	104.1	138.8	173.5	208.2	242.9	277.6	312.3
346	34.6	69.2	103.8	138.4	173.0	207.6	242.2	276.8	311.4
345	34.5	69.0	103.5	138.0	172.5	207.0	241.5	276.0	310.5
344	34.4	68.8	103.2	137.6	172.0	206.4	240.8	275.2	309.6
343	34.3	68.6	102.9	137.2	171.5	205.8	240.1	274.4	308.7
342	34.2	68.4	102.6	136.8	171.0	205 2	239.4	273.6	307.8
341	34.1	68.2	102.3	136.4	170.5	204.6	238.7	272.8	306.9
340	34.0	68.0	102.0	136.0	170.0	204.0	238.0	272.0	306.0
339	33.9	67.8	101.7	135.6	169.5	203.4	237.3	271.2	305.1
338	33.8	67.6	101.4	135.2	169.0	202.8	236.6	270.4	304.2
337	33.7	67.4	101.1	134.8	168.5	202.2	235.9	269.6	303.3
336	33.6	67.2	100.8	134.4	168.0	201.6	235.2	268.8	302.4
335	23.5	67.0	100.5	134.0	167.5	201.0	234.5	268.0	301.5
334	33.4	66.8	100.2	133.6	167.0	200.4	233.8	267.2	300.6
333	33.3	66.6	99.9	133.2	166.5	199.8	233.1	266.4	299.7
332	33.2	66.4	99.6	132.8	166.0	199.2	232.4	265.6	298.8
331	33.1	66.2	99.3	132.4	165.5	198.6	231.7	264.8	297.9
330	33.0	66.0	99.0	132.0	165.0	198.0	231.0	264.0	297.0
329	32.9	65.8	98.7	131.6	164.5	197.4	230.3	263.2	296.1
328	32.8	65.6	98.4	131.2	164.0	196.8	229.6	262.4	295.2
327	32.7	65.4	98.1	130.8	163.5	196.2	228.9	261.6	294.3
326	32.6	65.2	97.8	130.4	163.0	195.6	228.2	260.8	293.4
325	32.5	65.0	97.5	130.0	162.5	195.0	227.5	260.0	292.5
324	32.4	64.8	97.2	129.6	162.0	194.4	226.8	259.2	291.6
323	32.3	64.6	96.9	129.2	161.5	193.8	226.1	258.4	290.7
322	32.2	64.4	96.6	128.8	161.0	193.2	225.4	257.6	289.8

N.	0	1	2	3	4	5	6	7	8	9	Diff.
135	130334	0655	0977	1298	1619	1939	2260	2580	2900	3219	321
6	3539	3858	4177	4496	4814	5133	5451	5769	6086	6403	318
7	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564	316
8	9879	0194	0508	0822	1136	1450	1763	2076	2389	2702	314
9	143015	3327	3639	3951	4263	4574	4885	5196	5507	5818	311
140	6128	6438	6748	7058	7367	7676	7985	8294	8603	8911	309
1	9219	9527	9835	0142	0449	0756	1063	1370	1676	1982	307
2	152288	2594	2900	3205	3510	3815	4120	4424	4728	5032	305
3	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061	303
4	8362	8664	8965	9266	9567	9868	0168	0469	0769	1068	301
5	161368	1667	1967	2266	2564	2863	3161	3460	3758	4055	299
6	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022	297
7	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968	295
8	170262	0555	0848	1141	1434	1726	2019	2311	2603	2895	293
9	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802	291

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
321	32.1	64.2	96.3	128.4	160.5	192.6	224.7	256.8	288.9
320	32.0	64.0	96.0	128.0	160.0	192.0	224.0	256.0	288.0
319	31.9	63.8	95.7	127.6	159.5	191.4	223.3	255.2	287.1
318	31.8	63.6	95.4	127.2	159.0	190.8	222.6	254.4	286.2
317	31.7	63.4	95.1	126.8	158.5	190.2	221.9	253.6	285.3
316	31.6	63.2	94.8	126.4	158.0	189.6	221.2	252.8	284.4
315	31.5	63.0	94.5	126.0	157.5	189.0	220.5	252.0	283.5
314	31.4	62.8	94.2	125.6	157.0	188.4	219.8	251.2	282.6
313	31.3	62.6	93.9	125.2	156.5	187.8	219.1	250.4	281.7
312	31.2	62.4	93.6	124.8	156.0	187.2	218.4	249.6	280.8
311	31.1	62.2	93.3	124.4	155.5	186.6	217.7	248.8	279.9
310	31.0	62.0	93.0	124.0	155.0	186.0	217.0	248.0	279.0
309	30.9	61.8	92.7	123.6	154.5	185.4	216.3	247.2	278.1
308	30.8	61.6	92.4	123.2	154.0	184.8	215.6	246.4	277.2
307	30.7	61.4	92.1	122.8	153.5	184.2	214.9	245.6	276.3
306	30.6	61.2	91.8	122.4	153.0	183.6	214.2	244.8	275.4
305	30.5	61.0	91.5	122.0	152.5	183.0	213.5	244.0	274.5
304	30.4	60.8	91.2	121.6	152.0	182.4	212.8	243.2	273.6
303	30.3	60.6	90.9	121.2	151.5	181.8	212.1	242.4	272.7
302	30.2	60.4	90.6	120.8	151.0	181.2	211.4	241.6	271.8
301	30.1	60.2	90.3	120.4	150.5	180.6	210.7	240.8	270.9
300	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0	270.0
299	29.9	59.8	89.7	119.6	149.5	179.4	209.3	239.2	269.1
298	29.8	59.6	89.4	119.2	149.0	178.8	208.6	238.4	268.2
297	29.7	59.4	89.1	118.8	148.5	178.2	207.9	237.6	267.3
296	29.6	59.2	88.8	118.4	148.0	177.6	207.2	236.8	266.4
295	29.5	59.0	88.5	118.0	147.5	177.0	206.5	236.0	265.5
294	29.4	58.8	88.2	117.6	147.0	176.4	205.8	235.2	264.6
293	29.3	58.6	87.9	117.2	146.5	175.8	205.1	234.4	263.7
292	29.2	58.4	87.6	116.8	146.0	175.2	204.4	233.6	262.8
291	29.1	58.2	87.3	116.4	145.5	174.6	203.7	232.8	261.9
290	29.0	58.0	87.0	116.0	145.0	174.0	203.0	232.0	261.0
289	28.9	57.8	86.7	115.6	144.5	173.4	202.3	231.2	260.1
288	28.8	57.6	86.4	115.2	144.0	172.8	201.6	230.4	259.2
287	28.7	57.4	86.1	114.8	143.5	172.2	200.9	229.6	258.3
286	28.6	57.2	85.8	114.4	143.0	171.6	200.2	228.8	257.4

No. 150 L. 176.] [No. 169 L. 230.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
150	176091	6381	6670	6959	7248	7536	7825	8113	8401	8689	289
1	8977	9264	9552	9839	0126	0413	0699	0986	1272	1558	287
2	181844	2129	2415	2700	2985	3270	3555	3839	4123	4407	285
3	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239	283
4	7521	7803	8084	8366	8647	8928	9209	9490	9771	0051	281
5	190332	0612	0892	1171	1451	1730	2010	2289	2567	2846	279
6	3125	3403	3681	3959	4237	4514	4792	5069	5346	5623	278
7	5900	6176	6453	6729	7005	7281	7556	7832	8107	8382	276
8	8657	8932	9206	9481	9755	0029	0303	0577	0850	1124	274
9	201397	1670	1943	2216	2488	2761	3033	3305	3577	3848	272
160	4120	4391	4663	4934	5204	5475	5746	6016	6286	6556	271
1	6826	7096	7365	7634	7904	8173	8441	8710	8979	9247	269
2	9515	9783	0051	0319	0586	0853	1121	1388	1654	1921	267
3	212188	2454	2720	2986	3252	3518	3783	4049	4314	4579	266
4	4844	5109	5373	5638	5902	6166	6430	6694	6957	7221	264
5	7484	7747	8010	8273	8536	8798	9060	9323	9585	9846	262
6	220108	0370	0631	0892	1153	1414	1675	1936	2196	2456	261
7	2716	2976	3236	3496	3755	4015	4274	4533	4792	5051	259
8	5309	5568	5826	6084	6342	6600	6858	7115	7372	7630	258
9	7887	8144	8400	8657	8913	9170	9426	9682	9938	0193	256
	23										

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
285	28.5	57.0	85.5	114.0	142.5	171.0	199.5	228.0	256.5
284	28.4	56.8	85.2	113.6	142.0	170.4	198.8	227.2	255.6
283	28.3	56.6	84.9	113.2	141.5	169.8	198.1	226.4	254.7
282	28.2	56.4	84.6	112.8	141.0	169.2	197.4	225.6	253.8
281	28.1	56.2	84.3	112 4	140.5	168.6	196.7	224.8	252.9
280	28.0	56.0	84.0	112.0	140.0	168.0	196.0	224.0	252.0
279	27.9	55.8	83.7	111.6	139.5	167.4	195.3	223.2	251.1
278	27.8	55.6	83.4	111.2	139.0	166.8	194.6	222.4	250.2
277	27.7	55.4	83.1	110.8	138.5	166.2	193.9	221.6	249.3
276	27.6	55.2	82.8	110.4	138.0	165.6	193.2	220.8	248.4
275	27.5	55.0	82.5	110.0	137.5	165.0	192.5	220.0	247.5
274	27.4	54.8	82.2	109.6	137.0	164.4	191.8	219.2	246.6
273	27.3	54.6	81.9	109.2	136.5	163.8	191.1	218.4	245.7
272	27.2	54.4	81.6	108.8	136.0	163.2	190.4	217.6	244.8
271	27.1	54.2	81.3	108.4	135.5	162.6	189.7	216.8	243.9
270	27.0	54.0	81.0	108.0	135.0	162.0	189.0	216.0	243.0
269	26.9	53.8	80.7	107.6	134.5	161.4	188.3	215.2	242.1
268	26.8	53.6	80.4	107.2	134.0	160.8	187.6	214.4	241.2
267	26.7	53.4	80.1	106.8	133.5	160.2	186.9	213.6	240.3
266	26.6	53.2	79.8	106.4	133.0	159.6	186.2	212.8	239.4
265	26.5	53.0	79.5	106.0	132.5	159.0	185.5	212.0	238.5
264	26.4	52.8	79.2	105.6	132.0	158.4	184.8	211.2	237.6
263	26.3	52.6	78.9	105.2	131.5	157.8	184.1	210.4	236.7
262	26.2	52.4	78.6	104.8	131.0	157.2	183.4	209.6	235.8
261	26.1	52.2	78.3	104.4	130.5	156.6	182.7	208.8	234.9
260	26.0	52.0	78.0	104.0	130.0	156.0	182.0	208.0	234.0
259	25.9	51.8	77.7	103.6	129.5	155.4	181.3	207.2	233.1
258	25.8	51.6	77.4	103.2	129.0	154.8	180.6	206.4	232.2
257	25.7	51.4	77.1	102.8	128.5	154.2	179.9	205.6	231.3
256	25.6	51.2	76.8	102.4	128.0	153.6	179.2	204.8	230.4
255	25.5	51.0	76.5	102.0	127.5	153.0	178.5	204.0	229.5

No. 170 L. 230.] [No. 189 L. 278.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
170	230449	0704	0960	1215	1470	1724	1979	2234	2488	2742	255
1	2996	3250	3504	3757	4011	4264	4517	4770	5023	5276	253
2	5528	5781	6033	6285	6537	6789	7041	7292	7544	7795	252
3	8046	8297	8548	8799	9049	9299	9550	9800	0050	0300	250
4	240549	0799	1048	1297	1546	1795	2044	2293	2541	2790	249
5	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266	248
6	5513	5759	6006	6252	6499	6745	6991	7237	7482	7728	246
7	7973	8219	8464	8709	8954	9198	9443	9687	9932	0176	245
8	250420	0664	0908	1151	1395	1638	1881	2125	2368	2610	243
9	2853	3096	3338	3580	3822	4064	4306	4548	4790	5031	242
180	5273	5514	5755	5996	6237	6477	6718	6958	7198	7439	241
1	7679	7918	8158	8398	8637	8877	9116	9355	9594	9833	239
2	260071	0310	0548	0787	1025	1263	1501	1739	1976	2214	238
3	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582	237
4	4818	5054	5290	5525	5761	5996	6232	6467	6702	6937	235
5	7172	7406	7641	7875	8110	8344	8578	8812	9046	9279	234
6	9513	9746	9980	0213	0446	0679	0912	1144	1377	1609	233
7	271842	2074	2306	2538	2770	3001	3233	3464	3696	3927	232
8	4158	4389	4620	4850	5081	5311	5542	5772	6002	6232	230
9	6462	6692	6921	7151	7380	7609	7838	8067	8296	8525	229

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
255	25.5	51.0	76.5	102.0	127.5	153.0	178.5	204.0	229.5
254	25.4	50.8	76.2	101.6	127.0	152.4	177.8	203.2	228.6
253	25.3	50.6	75.9	101.2	126.5	151.8	177.1	202.4	227.7
252	25.2	50.4	75.6	100.8	126.0	151.2	176.4	201.6	226.8
251	25.1	50.2	75.3	100.4	125.5	150.6	175.7	200.8	225.9
250	25 0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0
249	24.9	49.8	74.7	99.6	124.5	149.4	174.3	199.2	224.1
248	24.8	49.6	74.4	99.2	124.0	148.8	173.6	198.4	223.2
247	24.7	49.4	74.1	98.8	123.5	148.2	172.9	197.6	222.3
246	24.6	49.2	73.8	98.4	123.0	147.6	172.2	196.8	221.4
245	24.5	49.0	73.5	98.0	122.5	147.0	171.5	196.0	220.5
244	24.4	48.8	73.2	97.6	122.0	146.4	170.8	195.2	219.6
243	24.3	48.6	72.9	97.2	121.5	145.8	170.1	194.4	218.7
242	24.2	48.4	72.6	96.8	121.0	145.2	169.4	193.6	217.8
241	24.1	48.2	72.3	96.4	120.5	144.6	168.7	192.8	216.9
240	24.0	48.0	72.0	96.0	120.0	144.0	168.0	192.0	216.0
239	23.9	47.8	71.7	95.6	119.5	143.4	167.3	191.2	215.1
238	23.8	47.6	71.4	95.2	119.0	142.8	166.6	190.4	214.2
237	23.7	47.4	71.1	94.8	118.5	142.2	165.9	189.6	213.3
236	23.6	47.2	70.8	94.4	118.0	141.6	165.2	188.8	212.4
235	23.5	47.0	70.5	94.0	117.5	141.0	164.5	188.0	211.5
234	23.4	46.8	70.2	93.6	117.0	140.4	163.8	187.2	210.6
233	23.3	46.6	69.9	93.2	116.5	139.8	163.1	186.4	209.7
232	23.2	46.4	69.6	92.8	116.0	139.2	162.4	185.6	208.8
231	23.1	46.2	69.3	92.4	115.5	138.6	161.7	184.8	207.9
230	23.0	46.0	69.0	92.0	115.0	138.0	161.0	184.0	207.0
229	22.9	45.8	68.7	91.6	114.5	137.4	160.3	183.2	206.1
228	22.8	45.6	68.4	91.2	114.0	136.8	159.6	182.4	205.2
227	22.7	45.4	68.1	90.8	113.5	136.2	158.9	181.6	204.3
226	22.6	45.2	67.8	90.4	113.0	135.6	158.2	180.8	203.4

N.	0	1	2	3	4	5	6	7	8	9	Diff.
190	278754	8982	9211	9439	9667	9895	0123	0351	0578	0806	228
1	281033	1261	1488	1715	1942	2169	2396	2622	2849	3075	227
2	3301	3527	3753	3979	4205	4431	4656	4882	5107	5332	226
3	5557	5782	6007	6232	6456	6681	6905	7130	7354	7578	225
4	7802	8026	8249	8473	8696	8920	9143	9366	9589	9812	223
5	290035	0257	0480	0702	0925	1147	1369	1591	1813	2034	222
6	2256	2478	2699	2920	3141	3363	3584	3804	4025	4246	221
7	4466	4687	4907	5127	5347	5567	5787	6007	6226	6446	220
8	6665	6884	7104	7323	7542	7761	7979	8198	8416	8635	219
9	8853	9071	9289	9507	9725	9943	0161	0378	0595	0813	218
200	301030	1247	1464	1681	1898	2114	2331	2547	2764	2980	217
1	3196	3412	3628	3844	4059	4275	4491	4706	4921	5136	216
2	5351	5566	5781	5996	6211	6425	6639	6854	7068	7282	215
3	7496	7710	7924	8137	8351	8564	8778	8991	9204	9417	213
4	9630	9843	0056	0268	0481	0693	0906	1118	1330	1542	212
5	311754	1966	2177	2389	2600	2812	3023	3234	3445	3656	211
6	3867	4078	4289	4499	4710	4920	5130	5340	5551	5760	210
7	5970	6180	6390	6599	6809	7018	7227	7436	7646	7854	209
8	8063	8272	8481	8689	8898	9106	9314	9522	9730	9938	208
9	320146	0354	0562	0769	0977	1184	1391	1598	1805	2012	207
210	2219	2426	2633	2839	3046	3252	3458	3665	3871	4077	206
1	4282	4488	4694	4899	5105	5310	5516	5721	5926	6131	205
2	6336	6541	6745	6950	7155	7359	7563	7767	7972	8176	204
3	8380	8583	8787	8991	9194	9398	9601	9805	0008	0211	203
4	330414	0617	0819	1022	1225	1427	1630	1832	2034	2236	202

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
225	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5
224	22.4	44.8	67.2	89.6	112.0	134.4	156.8	179.2	201.6
223	22.3	44.6	66.9	89.2	111.5	133.8	156.1	178.4	200.7
222	22.2	44.4	66.6	88.8	111.0	133.2	155.4	177.6	199.8
221	22.1	44.2	66.3	88.4	110.5	132.6	154.7	176.8	198.9
220	22.0	44.0	66.0	88.0	110.0	132.0	154.0	176.0	198.0
219	21.9	43.8	65.7	87.6	109.5	131.4	153.3	175.2	197.1
218	21.8	43.6	65.4	87.2	109.0	130.8	152.6	174.4	196.2
217	21.7	43.4	65.1	86.8	108.5	130.2	151.9	173.6	195.3
216	21.6	43.2	64.8	86.4	108.0	129.6	151.2	172.8	194.4
215	21.5	43.0	64.5	86.0	107.5	129.0	150.5	172.0	193.5
214	21.4	42.8	64.2	85.6	107.0	128.4	149.8	171.2	192.6
213	21.3	42.6	63.9	85.2	106.5	127.8	149.1	170.4	191.7
212	21.2	42.4	63.6	84.8	106.0	127.2	148.4	169.6	190.8
211	21.1	42.2	63.3	84.4	105.5	126.6	147.7	168.8	189.9
210	21.0	42.0	63.0	84.0	105.0	126.0	147.0	168.0	189.0
209	20.9	41.8	62.7	83.6	104.5	125.4	146.3	167.2	188.1
208	20.8	41.6	62.4	83.2	104.0	124.8	145.6	166.4	187.2
207	20.7	41.4	62.1	82.8	103.5	124.2	144.9	165.6	186.3
206	20.6	41.2	61.8	82.4	103.0	123.6	144.2	164.8	185.4
205	20.5	41.0	61.5	82.0	102.5	123.0	143.5	164.0	184.5
204	20.4	40.8	61.2	81.6	102.0	122.4	142.8	163.2	183.6
203	20.3	40.6	60.9	81.2	101.5	121.8	142.1	162.4	182.7
202	20.2	40.4	60.6	80.8	101.0	121.2	141.4	161.6	181.8

No. 215 L. 332.] [No. 239 L. 380.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
215	332438	2640	2842	3044	3246	3447	3649	3850	4051	4253	202
6	4454	4655	4856	5057	5257	5458	5658	5859	6059	6260	201
7	6460	6660	6860	7060	7260	7459	7659	7858	8058	8257	200
8	8456	8656	8855	9054	9253	9451	9650	9849	0047	0246	199
9	340444	0642	0841	1039	1237	1435	1632	1830	2028	2225	198
220	2423	2620	2817	3014	3212	3409	3606	3802	3999	4196	197
1	4392	4589	4785	4981	5178	5374	5570	5766	5962	6157	196
2	6353	6549	6744	6939	7135	7330	7525	7720	7915	8110	195
3	8305	8500	8694	8889	9083	9278	9472	9666	9860	0054	194
4	350248	0442	0636	0829	1023	1216	1410	1603	1796	1989	193
5	2183	2375	2568	2761	2954	3147	3339	3532	3724	3916	193
6	4108	4301	4493	4685	4876	5068	5260	5452	5643	5834	192
7	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744	191
8	7935	8125	8316	8506	8696	8886	9076	9266	9456	9646	190
9	9835	0025	0215	0404	0593	0783	0972	1161	1350	1539	189
230	361728	1917	2105	2294	2482	2671	2859	3048	3236	3424	188
1	3612	3800	3988	4176	4363	4551	4739	4926	5113	5301	188
2	5488	5675	5862	6049	6236	6423	6610	6796	6983	7169	187
3	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030	186
4	9216	9401	9587	9772	9958	0143	0328	0513	0698	0883	185
5	371068	1253	1437	1622	1806	1991	2175	2360	2544	2728	184
6	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565	184
7	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394	183
8	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216	182
9	8398	8580	8761	8943	9124	9306	9487	9668	9849	0030	181
	38										

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
202	20.2	40.4	60.6	80.8	101.0	121.2	141.4	161.6	181.8
201	20.1	40.2	60.3	80.4	100.5	120.6	140.7	160.8	180.9
200	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0
199	19.9	39.8	59.7	79.6	99.5	119.4	139.3	159.2	179.1
198	19.8	39.6	59.4	79.2	99.0	118.8	138.6	158.4	178.2
197	19.7	39.4	59.1	78.8	98.5	118.2	137.9	157.6	177.3
196	19.6	39.2	58.8	78.4	98 0	117.6	137.2	156.8	176.4
195	19.5	39.0	58.5	78.0	97.5	117.0	136.5	156.0	175.5
194	19.4	38.8	58.2	77.6	97.0	116.4	135.8	155.2	174.6
193	19.3	38.6	57.9	77.2	96.5	115.8	135.1	154.4	173.7
192	19.2	38.4	57.6	76.8	96.0	115.2	134.4	153.6	172.8
191	19.1	38.2	57.3	76.4	95.5	114.6	133.7	152.8	171.9
190	19.0	38.0	57.0	76.0	95.0	114.0	133.0	152.0	171.0
189	18.9	37.8	56.7	75.6	94 5	113.4	132.3	151.2	170.1
188	18.8	37.6	56.4	75.2	94.0	112.8	131.6	150.4	169.2
187	18.7	37 4	56.1	74.8	93.5	112.2	130.9	149.6	168.3
186	18.6	37.2	55.8	74.4	93.0	111.6	130.2	148.8	167.4
185	18.5	37.0	55.5	74.0	92.5	111.0	129.5	148.0	166.5
184	18 4	36.8	55.2	73.6	92.0	110.4	128.8	147.2	165.6
183	18 3	36.6	54.9	73.2	91.5	109.8	128.1	146.4	164.7
182	18 2	36.4	54 6	72.8	91.0	109.2	127.4	145.6	163.8
181	18 1	36.2	54.3	72.4	90.5	108 6	126.7	144.8	162.9
180	18.0	36.0	54.0	72.0	90 0	108.0	126.0	144.0	162.0
179	17.9	35.8	53.7	71.6	89.5	107.4	125.3	143.2	161.1

No. 240 L. 380.] [No. 269 L. 431.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
240	380211	0392	0573	0754	0934	1115	1296	1476	1656	1837	181
1	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	180
2	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	179
3	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	178
4	7390	7568	7746	7924	8101	8279	8456	8634	8811	8989	178
5	9166	9343	9520	9698	9875	0051	0228	0405	0582	0759	177
6	390935	1112	1288	1464	1641	1817	1993	2169	2345	2521	176
7	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	176
8	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	175
9	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	174
250	7940	8114	8287	8461	8634	8808	8981	9154	9328	9501	173
1	9674	9847	0020	0192	0365	0538	0711	0883	1056	1228	173
2	401401	1573	1745	1917	2089	2261	2433	2605	2777	2949	172
3	3121	3292	3464	3635	.3807	3978	4149	4320	4492	4663	171
4	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	171
5	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	170
6	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	169
7	9933	0102	0271	0440	0609	0777	0946	1114	1283	1451	169
8	411620	1788	1956	2124	2293	2461	2629	2796	2964	3132	168
9	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	167
260	4973	5140	5307	5474	5641	5808	5974	6141	6308	6474	167
1	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	166
2	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	165
3	9956	0121	0286	0451	0616	0781	0945	1110	1275	1439	165
4	421604	1768	1933	2097	2261	2426	2590	2754	2918	3082	164
5	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	164
6	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	163
7	6511	6674	6836	6999	7161	7324	7486	7648	7811	7973	162
8	8135	8297	8459	8621	8783	8944	9106	9268	9429	9591	162
9	9752 43	9914	0075	0236	0398	0559	0720	0881	1042	1203	161

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
178	17.8	35.6	53.4	71.2	89.0	106.8	124.6	142.4	160.2
177	17.7	35.4	53.1	70.8	88.5	106.2	123.9	141.6	159.3
176	17.6	35.2	52.8	70.4	88.0	105.6	123.2	140.8	158.4
175	17.5	35.0	52.5	70.0	87.5	105.0	122.5	140.0	157.5
174	17.4	34.8	52.2	69.6	87.0	104.4	121.8	139.2	156.6
173	17.3	34.6	51.9	69.2	86.5	103.8	121.1	138.4	155.7
172	17.2	34.4	51.6	68.8	86.0	103.2	120.4	137.6	154.8
171	17.1	34.2	51.3	68.4	85.5	102.6	119.7	136.8	153.9
170	17.0	34.0	51.0	68.0	85.0	102.0	119.0	136.0	153.0
169	16.9	33.8	50.7	67.6	84.5	101.4	118.3	135.2	152.1
168	16.8	33.6	50.4	67.2	84.0	100.8	117.6	134.4	151.2
167	16.7	33.4	50.1	66.8	83.5	100.2	116.9	133.6	150.3
166	16.6	33.2	49.8	66.4	83.0	99.6	116.2	132.8	149.4
165	16.5	33.0	49.5	66.0	82.5	99.0	115.5	132.0	148.5
164	16.4	32.8	49.2	65.6	82.0	98.4	114.8	131.2	147.6
163	16.3	32.6	48.9	65.2	81.5	97.8	114.1	130.4	146.7
162	16.2	32.4	48.5	64.8	81.0	97.2	113.4	129.6	145.8
161	16.1	32.2	48.3	64.4	80.5	96.6	112.7	128.8	144.9

No. 270 L. 431.] [No. 299 L. 476.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
270	431364	1525	1685	1846	2007	2167	2328	2488	2649	2809	161
1	2969	3130	3290	3450	3610	3770	3930	4090	4249	4409	160
2	4569	4729	4888	5048	5207	5367	5526	5685	5844	6004	159
3	6163	6322	6481	6640	6799	6957	7116	7275	7433	7592	159
4	7751	7909	8067	8226	8384	8542	8701	8859	9017	9175	158
5	9333	9491	9648	9806	9964						
						0122	0279	0437	0594	0752	158
6	440909	1066	1224	1381	1538	1695	1852	2009	2166	2323	157
7	2480	2637	2793	2950	3106	3263	3419	3576	3732	3889	157
8	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	156
9	5604	5760	5915	6071	6226	6382	6537	6692	6848	7003	155
280	7158	7313	7468	7623	7778	7933	8088	8242	8397	8552	155
1	8706	8861	9015	9170	9324	9478	9633	9787	9941		
										0095	154
2	450249	0403	0557	0711	0865	1018	1172	1326	1479	1633	154
3	1786	1940	2093	2247	2400	2553	2706	2859	3012	3165	153
4	3318	3471	3624	3777	3930	4082	4235	4387	4540	4692	153
5	4845	4997	5150	5302	5454	5606	5758	5910	6062	6214	152
6	6366	6518	6670	6821	6973	7125	7276	7428	7579	7731	152
7	7882	8033	8184	8336	8487	8638	8789	8940	9091	9242	151
8	9392	9543	9694	9845	9995						
						0146	0296	0447	0597	0748	151
9	460898	1048	1198	1348	1499	1649	1799	1948	2098	2248	150
290	2398	2548	2697	2847	2997	3146	3296	3445	3594	3744	150
1	3893	4042	4191	4340	4490	4639	4788	4936	5085	5234	149
2	5383	5532	5680	5829	5977	6126	6274	6423	6571	6719	149
3	6868	7016	7164	7312	7460	7608	7756	7904	8052	8200	148
4	8347	8495	8643	8790	8938	9085	9233	9380	9527	9675	148
5	9822	9969									
			0116	0263	0410	0557	0704	0851	0998	1145	147
6	471292	1438	1585	1732	1878	2025	2171	2318	2464	2610	146
7	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	146
8	4216	4362	4508	4653	4799	4944	5090	5235	5381	5526	146
9	5671	5816	5962	6107	6252	6397	6542	6687	6832	6976	145

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
161	16.1	32.2	48.3	64.4	80.5	96.6	112.7	128.8	144.9
160	16.0	32.0	48.0	64.0	80.0	96.0	112.0	128.0	144.0
159	15.9	31.8	47.7	63.6	79.5	95.4	111.3	127.2	143.1
158	15.8	31.6	47.4	63.2	79.0	94.8	110.6	126.4	142.2
157	15.7	31.4	47.1	62.8	78.5	94.2	109.9	125.6	141.3
156	15.6	31.2	46.8	62.4	78.0	93.6	109.2	124.8	140.4
155	15.5	31.0	46.5	62.0	77.5	93.0	108.5	124.0	139.5
154	15.4	30.8	46.2	61.6	77.0	92.4	107.8	123.2	138.6
153	15.3	30.6	45.9	61.2	76.5	91.8	107.1	122.4	137.7
152	15.2	30.4	45.6	60.8	76.0	91.2	106.4	121.6	136.8
151	15.1	30.2	45.3	60.4	75.5	90.6	105.7	120.8	135.9
150	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0
149	14.9	29.8	44.7	59.6	74.5	89.4	104.3	119.2	134.1
148	14.8	29.6	44.4	59.2	74.0	88.8	103.6	118.4	133.2
147	14.7	29.4	44.1	58.8	73.5	88.2	102.9	117.6	132.3
146	14.6	29.2	43.8	58.4	73.0	87.6	102.2	116.8	131.4
145	14.5	29.0	43.5	58.0	72.5	87.0	101.5	116.0	130.5
144	14.4	28.8	43.2	57.6	72.0	86.4	100.8	115.2	129.6
143	14.3	28.6	42.9	57.2	71.5	85.8	100.1	114.4	128.7
142	14.2	28.4	42.6	56.8	71.0	85.2	99.4	113.6	127.8
141	14.1	28.2	42.3	56.4	70.5	84.6	98.7	112.8	126.9
140	14.0	28.0	42.0	56.0	70.0	84.0	98.0	112.0	126.0

No. 300 L. 477.] [No. 339 L. 531.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
300	477121	7266	7411	7555	7700	7844	7989	8133	8278	8422	145
1	8566	8711	8855	8999	9143	9287	9431	9575	9719	9863	144
2	480007	0151	0294	0438	0582	0725	0869	1012	1156	1299	144
3	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	143
4	2874	3016	3159	3302	3445	3587	3730	3872	4015	4157	143
5	4300	4442	4585	4727	4869	5011	5153	5295	5437	5579	142
6	5721	5863	6005	6147	6289	6430	6572	6714	6855	6997	142
7	7138	7280	7421	7563	7704	7845	7986	8127	8269	8410	141
8	8551	8692	8833	8974	9114	9255	9396	9537	9677	9818	141
9	9958	0099	0239	0380	0520	0661	0801	0941	1081	1222	140
310	491362	1502	1642	1782	1922	2062	2201	2341	2481	2621	140
1	2760	2900	3040	3179	3319	3458	3597	3737	3876	4015	139
2	4155	4294	4433	4572	4711	4850	4989	5128	5267	5406	139
3	5544	5683	5822	5960	6099	6238	6376	6515	6653	6791	139
4	6930	7068	7206	7344	7483	7621	7759	7897	8035	8173	138
5	8311	8448	8586	8724	8862	8999	9137	9275	9412	9550	138
6	9687	9824	9962	0099	0236	0374	0511	0648	0785	0922	137
7	501059	1196	1333	1470	1607	1744	1880	2017	2154	2291	137
8	2427	2564	2700	2837	2973	3109	3246	3382	3518	3655	136
9	3791	3927	4063	4199	4335	4471	4607	4743	4878	5014	136
320	5150	5286	5421	5557	5693	5828	5964	6099	6234	6370	136
1	6505	6640	6776	6911	7046	7181	7316	7451	7586	7721	135
2	7856	7991	8126	8260	8395	8530	8664	8799	8934	9068	135
3	9203	9337	9471	9606	9740	9874	0009	0143	0277	0411	134
4	510545	0679	0813	0947	1081	1215	1349	1482	1616	1750	134
5	1883	2017	2151	2284	2418	2551	2684	2818	2951	3084	133
6	3218	3351	3484	3617	3750	3883	4016	4149	4282	4415	133
7	4548	4681	4813	4946	5079	5211	5344	5476	5609	5741	133
8	5874	6006	6139	6271	6403	6535	6668	6800	6932	7064	132
9	7196	7328	7460	7592	7724	7855	7987	8119	8251	8382	132
330	8514	8646	8777	8909	9040	9171	9303	9434	9566	9697	131
1	9828	9959	0090	0221	0353	0484	0615	0745	0876	1007	131
2	521138	1269	1400	1530	1661	1792	1922	2053	2183	2314	131
3	2444	2575	2705	2835	2966	3096	3226	3356	3486	3616	130
4	3746	3876	4006	4136	4266	4396	4526	4656	4785	4915	130
5	5045	5174	5304	5434	5563	5693	5822	5951	6081	6210	129
6	6339	6469	6598	6727	6856	6985	7114	7243	7372	7501	129
7	7630	7759	7888	8016	8145	8274	8402	8531	8660	8788	129
8	8917	9045	9174	9302	9430	9559	9687	9815	9943	0072	128
9	530200	0328	0456	0584	0712	0840	0968	1096	1223	1351	128

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
139	13.9	27.8	41.7	55.6	69.5	83.4	97.3	111.2	125.1
138	13.8	27.6	41.4	55.2	69.0	82.8	96.6	110.4	124.2
137	13.7	27.4	41.1	54.8	68.5	82.2	95.9	109.6	123.3
136	13.6	27.2	40.8	54.4	68.0	81.6	95.2	108.8	122.4
135	13.5	27.0	40.5	54.0	67.5	81.0	94.5	108.0	121.5
134	13.4	26.8	40.2	53.6	67.0	80.4	93.8	107.2	120.6
133	13.3	26.6	39.9	53.2	66.5	79.8	93.1	106.4	119.7
132	13.2	26.4	39.6	52.8	66.0	79.2	92.4	105.6	118.8
131	13.1	26.2	39.3	52.4	65.5	78.6	91.7	104.8	117.9
130	13.0	26.0	39.0	52.0	65.0	78.0	91.0	104.0	117.0
129	12.9	25.8	38.7	51.6	64.5	77.4	90.3	103.2	116.1
128	12.8	25.6	38.4	51.2	64.0	76.8	89.6	102.4	115.2
127	12.7	25.4	38.1	50.8	63.5	76.2	88.9	101.6	114.3

No. 340 L. 531.] [No. 379 L. 579.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
340	531479	1607	1734	1862	1990	2117	2245	2372	2500	2627	128
1	2754	2882	3009	3136	3264	3391	3518	3645	3772	3899	127
2	4026	4153	4280	4407	4534	4661	4787	4914	5041	5167	127
3	5294	5421	5547	5674	5800	5927	6053	6180	6306	6432	126
4	6558	6685	6811	6937	7063	7189	7315	7441	7567	7693	126
5	7819	7945	8071	8197	8322	8448	8574	8699	8825	8951	126
6	9076	9202	9327	9452	9578	9703	9829	9954	0079	0204	125
7	540329	0455	0580	0705	0830	0955	1080	1205	1330	1454	125
8	1579	1704	1829	1953	2078	2203	2327	2452	2576	2701	125
9	2825	2950	3074	3199	3323	3447	3571	3696	3820	3944	124
350	4068	4192	4316	4440	4564	4688	4812	4936	5060	5183	124
1	5307	5431	5555	5678	5802	5925	6049	6172	6296	6419	124
2	6543	6666	6789	6913	7036	7159	7282	7405	7529	7652	123
3	7775	7898	8021	8144	8267	8389	8512	8635	8758	8881	123
4	9003	9126	9249	9371	9494	9616	9739	9861	9984	0106	123
5	550228	0351	0473	0595	0717	0840	0962	1084	1206	1328	122
6	1450	1572	1694	1816	1938	2060	2181	2303	2425	2547	122
7	2668	2790	2911	3033	3155	3276	3398	3519	3640	3762	121
8	3883	4004	4126	4247	4368	4489	4610	4731	4852	4973	121
9	5094	5215	5336	5457	5578	5699	5820	5940	6061	6182	121
360	6303	6423	6544	6664	6785	6905	7026	7146	7267	7387	120
1	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	120
2	8709	8829	8948	9068	9188	9308	9428	9548	9667	9787	120
3	9907	0026	0146	0265	0385	0504	0624	0743	0863	0982	119
4	561101	1221	1340	1459	1578	1698	1817	1936	2055	2174	119
5	2293	2412	2531	2650	2769	2887	3006	3125	3244	3362	119
6	3481	3600	3718	3837	3955	4074	4192	4311	4429	4548	119
7	4666	4784	4903	5021	5139	5257	5376	5494	5612	5730	118
8	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	118
9	7026	7144	7262	7379	7497	7614	7732	7849	7967	8084	118
370	8202	8319	8436	8554	8671	8788	8905	9023	9140	9257	117
1	9374	9491	9608	9725	9842	9959	0076	0193	0309	0426	117
2	570543	0660	0776	0893	1010	1126	1243	1359	1476	1592	117
3	1709	1825	1942	2058	2174	2291	2407	2523	2639	2755	116
4	2872	2988	3104	3220	3336	3452	3568	3684	3800	3915	116
5	4031	4147	4263	4379	4494	4610	4726	4841	4957	5072	116
6	5188	5303	5419	5534	5650	5765	5880	5996	6111	6226	115
7	6341	6457	6572	6687	6802	6917	7032	7147	7262	7377	115
8	7492	7607	7722	7836	7951	8066	8181	8295	8410	8525	115
9	8639	8754	8868	8983	9097	9212	9326	9441	9555	9669	114

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
128	12.8	25.6	38.4	51.2	64.0	76.8	89.6	102.4	115.2
127	12 7	25 4	38.1	50.8	63.5	76.2	88.9	101.6	114.3
126	12 6	25.2	37.8	50.4	63.0	75.6	88.2	100.8	113.4
125	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5
124	12.4	24.8	37.2	49.6	62.0	74.4	86 8	99.2	111.6
123	12.3	24.6	36.9	49.2	61.5	73.8	86.1	98.4	110.7
122	12.2	24.4	36.6	48.8	61.0	73.2	85.4	97.6	109.8
121	12.1	24.2	36.3	48.4	60.5	72.6	84.7	96.8	108.9
120	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0
119	11.9	23.8	35.7	47.6	59.5	71.4	83.3	95.2	107.1

No. 380. L. 579.] [No. 414 L. 617.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
380	579784	9898	0012	0126	0241	0355	0469	0583	0697	0811	114
1	580925	1039	1153	1267	1381	1495	1608	1722	1836	1950	
2	2063	2177	2291	2404	2518	2631	2745	2858	2972	3085	
3	3199	3312	3426	3539	3652	3765	3879	3992	4105	4218	
4	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	113
5	5461	5574	5686	5799	5912	6024	6137	6250	6362	6475	
6	6587	6700	6812	6925	7037	7149	7262	7374	7486	7599	
7	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	112
8	8832	8944	9056	9167	9279	9391	9503	9615	9726	9838	
9	9950	0061	0173	0284	0396	0507	0619	0730	0842	0953	
390	591065	1176	1287	1399	1510	1621	1732	1843	1955	2066	
1	2177	2288	2399	2510	2621	2732	2843	2954	3064	3175	111
2	3286	3397	3508	3618	3729	3840	3950	4061	4171	4282	
3	4393	4503	4614	4724	4834	4945	5055	5165	5276	5386	
4	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	
5	6597	6707	6817	6927	7037	7146	7256	7366	7476	7586	110
6	7695	7805	7914	8024	8134	8243	8353	8462	8572	8681	
7	8791	8900	9009	9119	9228	9337	9446	9556	9665	9774	
8	9883	9992	0101	0210	0319	0428	0537	0646	0755	0864	109
9	600973	1082	1191	1299	1408	1517	1625	1734	1843	1951	
400	2060	2169	2277	2386	2494	2603	2711	2819	2928	3036	
1	3144	3253	3361	3469	3577	3686	3794	3902	4010	4118	108
2	4226	4334	4442	4550	4658	4766	4874	4982	5089	5197	
3	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	
4	6381	6489	6596	6704	6811	6919	7026	7133	7241	7348	
5	7455	7562	7669	7777	7884	7991	8098	8205	8312	8419	107
6	8526	8633	8740	8847	8954	9061	9167	9274	9381	9488	
7	9594	9701	9808	9914	0021	0128	0234	0341	0447	0554	
8	610660	0767	0873	0979	1086	1192	1298	1405	1511	1617	
9	1723	1829	1936	2042	2148	2254	2360	2466	2572	2678	106
410	2784	2890	2996	3102	3207	3313	3419	3525	3630	3736	
1	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	
2	4897	5003	5108	5213	5319	5424	5529	5634	5740	5845	
3	5950	6055	6160	6265	6370	6476	6581	6686	6790	6895	105
4	7000	7105	7210	7315	7420	7525	7629	7734	7839	7943	

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
118	11.8	23.6	35.4	47.2	59.0	70.8	82.6	94.4	106.2
117	11.7	23.4	35.1	46.8	58.5	70.2	81.9	93.6	105.3
116	11.6	23.2	34.8	46.4	58.0	69.6	81.2	92.8	104.4
115	11.5	23.0	34.5	46.0	57.5	69.0	80.5	92.0	103.5
114	11.4	22.8	34.2	45.6	57.0	68.4	79.8	91.2	102.6
113	11.3	22.6	33.9	45.2	56.5	67.8	79.1	90.4	101.7
112	11.2	22.4	33.6	44.8	56.0	67.2	78.4	89.6	100.8
111	11.1	22.2	33.3	44.4	55.5	66.6	77.7	88.8	99.9
110	11.0	22.0	33.0	44.0	55.0	66.0	77.0	88.0	99.0
109	10.9	21.8	32.7	43.6	54.5	65.4	76.3	87.2	98.1
108	10.8	21.6	32.4	43.2	54.0	64.8	75.6	86.4	97.2
107	10.7	21.4	32.1	42.8	53.5	64.2	74.9	85.6	96.3
106	10.6	21.2	31.8	42.4	53.0	63.6	74.2	84.8	95.4
105	10.5	21.0	31.5	42.0	52.5	63.0	73.5	84.0	94.5
105	10.5	21.0	31.5	42.0	52.5	63.0	73.5	84.0	94.5
104	10.4	20.8	31.2	41.6	52.0	62.4	72.8	83.2	93.6

No. 415 L. 618.] [No. 459 L. 662.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
415	618048	8153	8257	8362	8466	8571	8676	8780	8884	8989	105
6	9093	9198	9302	9406	9511	9615	9719	9824	9928	0032	
7	620136	0240	0344	0448	0552	0656	0760	0864	0968	1072	104
8	1176	1280	1384	1488	1592	1695	1799	1903	2007	2110	
9	2214	2318	2421	2525	2628	2732	2835	2939	3042	3146	
420	3249	3353	3456	3559	3663	3766	3869	3973	4076	4179	
1	4282	4385	4488	4591	4695	4798	4901	5004	5107	5210	103
2	5312	5415	5518	5621	5724	5827	5929	6032	6135	6238	
3	6340	6443	6546	6648	6751	6853	6956	7058	7161	7263	
4	7366	7468	7571	7673	7775	7878	7980	8082	8185	8287	
5	8389	8491	8593	8695	8797	8900	9002	9104	9206	9308	102
6	9410	9512	9613	9715	9817	9919	0021	0123	0224	0326	
7	630428	0530	0631	0733	0835	0936	1038	1139	1241	1342	
8	1444	1545	1647	1748	1849	1951	2052	2153	2255	2356	
9	2457	2559	2660	2761	2862	2963	3064	3165	3266	3367	
430	3468	3569	3670	3771	3872	3973	4074	4175	4276	4376	101
1	4477	4578	4679	4779	4880	4981	5081	5182	5283	5383	
2	5484	5584	5685	5785	5886	5986	6087	6187	6287	6388	
3	6488	6588	6688	6789	6889	6989	7089	7189	7290	7390	
4	7490	7590	7690	7790	7890	7990	8090	8190	8290	8389	100
5	8489	8589	8689	8789	8888	8988	9088	9188	9287	9387	
6	9486	9586	9686	9785	9885	9984	0084	0183	0283	0382	
7	640481	0581	0680	0779	0879	0978	1077	1177	1276	1375	
8	1474	1573	1672	1771	1871	1970	2069	2168	2267	2366	
9	2465	2563	2662	2761	2860	2959	3058	3156	3255	3354	99
440	3453	3551	3650	3749	3847	3946	4044	4143	4242	4340	
1	4439	4537	4636	4734	4832	4931	5029	5127	5226	5324	
2	5422	5521	5619	5717	5815	5913	6011	6110	6208	6306	
3	6404	6502	6600	6698	6796	6894	6992	7089	7187	7285	98
4	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	
5	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	
6	9335	9432	9530	9627	9724	9821	9919	0016	0113	0210	
7	650308	0405	0502	0599	0696	0793	0890	0987	1084	1181	
8	1278	1375	1472	1569	1666	1762	1859	1956	2053	2150	97
9	2246	2343	2440	2536	2633	2730	2826	2923	3019	3116	
450	3213	3309	3405	3502	3598	3695	3791	3888	3984	4080	
1	4177	4273	4369	4465	4562	4658	4754	4850	4946	5042	
2	5138	5235	5331	5427	5523	5619	5715	5810	5906	6002	96
3	6098	6194	6290	6386	6482	6577	6673	6769	6864	6960	
4	7056	7152	7247	7343	7438	7534	7629	7725	7820	7916	
5	8011	8107	8202	8298	8393	8488	8584	8679	8774	8870	
6	8965	9060	9155	9250	9346	9441	9536	9631	9726	9821	
7	9916	0011	0106	0201	0296	0391	0486	0581	0676	0771	95
8	660865	0960	1055	1150	1245	1339	1434	1529	1623	1718	
9	1813	1907	2002	2096	2191	2286	2380	2475	2569	2663	

PROPORTIONAL PARTS.

Diff	1	2	3	4	5	6	7	8	9
105	10 5	21.0	31 5	42.0	52 5	63 0	73.5	84 0	94.5
104	10 4	20 8	31 2	41 6	52.0	62 4	72 8	83 2	93.6
103	10 3	20 6	30 9	41.2	51 5	61 8	72 1	82.4	92 7
102	10 2	20 4	30 6	40.8	51 0	61 2	71 4	81 6	91 8
101	10 1	20 2	30 3	40.4	50 5	60 6	70 7	80 8	90.9
100	10.0	20 0	30.0	40 0	50 0	60.0	70 0	80 0	90 0
99	9 9	19 8	29 7	39 6	49 5	59 4	69 3	79 2	89.1

No. 460 L. 662.] [No. 499 L. 698.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
460	662758	2852	2947	3041	3135	3230	3324	3418	3512	3607	
1	3701	3795	3889	3983	4078	4172	4266	4360	4454	4548	
2	4642	4736	4830	4924	5018	5112	5206	5299	5393	5487	94
3	5581	5675	5769	5862	5956	6050	6143	6237	6331	6424	
4	6518	6612	6705	6799	6892	6986	7079	7173	7266	7360	
5	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	
6	8386	8479	8572	8665	8759	8852	8945	9038	9131	9224	
7	9317	9410	9503	9596	9689	9782	9875	9967	0060	0153	93
8	670246	0339	0431	0524	0617	0710	0802	0895	0988	1080	
9	1173	1265	1358	1451	1543	1636	1728	1821	1913	2005	
470	2098	2190	2283	2375	2467	2560	2652	2744	2836	2929	
1	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	
2	3942	4034	4126	4218	4310	4402	4494	4586	4677	4769	92
3	4861	4953	5045	5137	5228	5320	5412	5503	5595	5687	
4	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	
5	6694	6785	6876	6968	7059	7151	7242	7333	7424	7516	
6	7607	7698	7789	7881	7972	8063	8154	8245	8336	8427	
7	8518	8609	8700	8791	8882	8973	9064	9155	9246	9337	91
8	9428	9519	9610	9700	9791	9882	9973	0063	0154	0245	
9	680336	0426	0517	0607	0698	0789	0879	0970	1060	1151	
480	1241	1332	1422	1513	1603	1693	1784	1874	1964	2055	
1	2145	2235	2326	2416	2506	2596	2686	2777	2867	2957	
2	3047	3137	3227	3317	3407	3497	3587	3677	3767	3857	90
3	3947	4037	4127	4217	4307	4396	4486	4576	4666	4756	
4	4845	4935	5025	5114	5204	5294	5383	5473	5563	5652	
5	5742	5831	5921	6010	6100	6189	6279	6368	6458	6547	
6	6636	6726	6815	6904	6994	7083	7172	7261	7351	7440	
7	7529	7618	7707	7796	7886	7975	8064	8153	8242	8331	89
8	8420	8509	8598	8687	8776	8865	8953	9042	9131	9220	
9	9309	9398	9486	9575	9664	9753	9841	9930	0019	0107	
490	690196	0285	0373	0462	0550	0639	0728	0816	0905	0993	
1	1081	1170	1258	1347	1435	1524	1612	1700	1789	1877	
2	1965	2053	2142	2230	2318	2406	2494	2583	2671	2759	
3	2847	2935	3023	3111	3199	3287	3375	3463	3551	3639	88
4	3727	3815	3903	3991	4078	4166	4254	4342	4430	4517	
5	4605	4693	4781	4868	4956	5044	5131	5219	5307	5394	
6	5482	5569	5657	5744	5832	5919	6007	6094	6182	6269	
7	6356	6444	6531	6618	6706	6793	6880	6968	7055	7142	
8	7229	7317	7404	7491	7578	7665	7752	7839	7926	8014	
9	8100	8188	8275	8362	8449	8535	8622	8709	8796	8883	87

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
98	9.8	19.6	29.4	39.2	49.0	58.8	68.6	78.4	88.2
97	9.7	19.4	29.1	38.8	48.5	58.2	67.9	77.6	87.3
96	9.6	19.2	28.8	38.4	48.0	57.6	67.2	76.8	86.4
95	9.5	19.0	28.5	38.0	47.5	57.0	66.5	76.0	85.5
94	9.4	18.8	28.2	37.6	47.0	56.4	65.8	75.2	84.6
93	9.3	18.6	27.9	37.2	46.5	55.8	65.1	74.4	83.7
92	9.2	18.4	27.6	36.8	46.0	55.2	64.4	73.6	82.8
91	9.1	18.2	27.3	36.4	45.5	54.6	63.7	72.8	81.9
90	9.0	18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0
89	8.9	17.8	26.7	35.6	44.5	53.4	62.3	71.2	80.1
88	8.8	17.6	26.4	35.2	44.0	52.8	61.6	70.4	79.2
87	8.7	17.4	26.1	34.8	43.5	52.2	60.9	69.6	78.3
86	8.6	17.2	25.8	34.4	43.0	51.6	60.2	68.8	77.4

No. 500 L. 698.] [No. 544 L. 736.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
500	698970	9057	9144	9231	9317	9404	9491	9578	9664	9751	
1	9838	9924	0011	0098	0184	0271	0358	0444	0531	0617	
2	700704	0790	0877	0963	1050	1136	1222	1309	1395	1482	
3	1568	1654	1741	1827	1913	1999	2086	2172	2258	2344	
4	2431	2517	2603	2689	2775	2861	2947	3033	3119	3205	
5	3291	3377	3463	3549	3635	3721	3807	3893	3979	4065	86
6	4151	4236	4322	4408	4494	4579	4665	4751	4837	4922	
7	5008	5094	5179	5265	5350	5436	5522	5607	5693	5778	
8	5864	5949	6035	6120	6206	6291	6376	6462	6547	6632	
9	6718	6803	6888	6974	7059	7144	7229	7315	7400	7485	
510	7570	7655	7740	7826	7911	7996	8081	8166	8251	8336	
1	8421	8506	8591	8676	8761	8846	8931	9015	9100	9185	85
2	9270	9355	9440	9524	9609	9694	9779	9863	9948	0033	
3	710117	0202	0287	0371	0456	0540	0625	0710	0794	0879	
4	0963	1048	1132	1217	1301	1385	1470	1554	1639	1723	
5	1807	1892	1976	2060	2144	2229	2313	2397	2481	2566	
6	2650	2734	2818	2902	2986	3070	3154	3238	3323	3407	
7	3491	3575	3659	3742	3826	3910	3994	4078	4162	4246	84
8	4330	4414	4497	4581	4665	4749	4833	4916	5000	5084	
9	5167	5251	5335	5418	5502	5586	5669	5753	5836	5920	
520	6003	6087	6170	6254	6337	6421	6504	6588	6671	6754	
1	6838	6921	7004	7088	7171	7254	7338	7421	7504	7587	
2	7671	7754	7837	7920	8003	8086	8169	8253	8336	8419	
3	8502	8585	8668	8751	8834	8917	9000	9083	9165	9248	83
4	9331	9414	9497	9580	9663	9745	9828	9911	9994	0077	
5	720159	0242	0325	0407	0490	0573	0655	0738	0821	0903	
6	0986	1068	1151	1233	1316	1398	1481	1563	1646	1728	
7	1811	1893	1975	2058	2140	2222	2305	2387	2469	2552	
8	2634	2716	2798	2881	2963	3045	3127	3209	3291	3374	
9	3456	3538	3620	3702	3784	3866	3948	4030	4112	4194	82
530	4276	4358	4440	4522	4604	4685	4767	4849	4931	5013	
1	5095	5176	5258	5340	5422	5503	5585	5667	5748	5830	
2	5912	5993	6075	6156	6238	6320	6401	6483	6564	6646	
3	6727	6809	6890	6972	7053	7134	7216	7297	7379	7460	
4	7541	7623	7704	7785	7866	7948	8029	8110	8191	8273	
5	8354	8435	8516	8597	8678	8759	8841	8922	9003	9084	
6	9165	9246	9327	9408	9489	9570	9651	9732	9813	9893	81
7	9974	0055	0136	0217	0298	0378	0459	0540	0621	0702	
8	730782	0863	0944	1024	1105	1186	1266	1347	1428	1508	
9	1589	1669	1750	1830	1911	1991	2072	2152	2233	2313	
540	2394	2474	2555	2635	2715	2796	2876	2956	3037	3117	
1	3197	3278	3358	3438	3518	3598	3679	3759	3839	3919	
2	3999	4079	4160	4240	4320	4400	4480	4560	4640	4720	80
3	4800	4880	4960	5040	5120	5200	5279	5359	5439	5519	
4	5599	5679	5759	5838	5918	5998	6078	6157	6237	6317	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
87	8.7	17.4	26.1	34.8	43.5	52.2	60.9	69.6	78.3
86	8.6	17.2	25.8	34.4	43.0	51.6	60.2	68.8	77.4
85	8.5	17.0	25.5	34.0	42.5	51.0	59.5	68.0	76.5
84	8.4	16.8	25.2	33.6	42.0	50.4	58.8	67.2	75.6

No. 545 L. 736.] [No. 584 L. 767.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
545	736397	6476	6556	6635	6715	6795	6874	6954	7034	7113	
6	7193	7272	7352	7431	7511	7590	7670	7749	7829	7908	
7	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701	
8	8781	8860	8939	9018	9097	9177	9256	9335	9414	9493	
9	9572	9651	9731	9810	9889	9968	0047	0126	0205	0284	79
550	740363	0442	0521	0600	0678	0757	0836	0915	0994	1073	
1	1152	1230	1309	1388	1467	1546	1624	1703	1782	1860	
2	1939	2018	2096	2175	2254	2332	2411	2489	2568	2647	
3	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431	
4	3510	3588	3667	3745	3823	3902	3980	4058	4136	4215	
5	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997	
6	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777	
7	5855	5933	6011	6089	6167	6245	6323	6401	6479	6556	78
8	6634	6712	6790	6868	6945	7023	7101	7179	7256	7334	
9	7412	7489	7567	7645	7722	7800	7878	7955	8033	8110	
560	8188	8266	8343	8421	8498	8576	8653	8731	8808	8885	
1	8963	9040	9118	9195	9272	9350	9427	9504	9582	9659	
2	9736	9814	9891	9968	0045	0123	0200	0277	0354	0431	
3	750508	0586	0663	0740	0817	0894	0971	1048	1125	1202	
4	1279	1356	1433	1510	1587	1664	1741	1818	1895	1972	
5	2048	2125	2202	2279	2356	2433	2509	2586	2663	2740	77
6	2816	2893	2970	3047	3123	3200	3277	3353	3430	3506	
7	3583	3660	3736	3813	3889	3966	4042	4119	4195	4272	
8	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036	
9	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799	
570	5875	5951	6027	6103	6180	6256	6332	6408	6484	6560	
1	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320	76
2	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079	
3	8155	8230	8306	8382	8458	8533	8609	8685	8761	8836	
4	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592	
5	9668	9743	9819	9894	9970	0045	0121	0196	0272	0347	
6	760422	0498	0573	0649	0724	0799	0875	0950	1025	1101	
7	1176	1251	1326	1402	1477	1552	1627	1702	1778	1853	
8	1928	2003	2078	2153	2228	2303	2378	2453	2529	2604	
9	2679	2754	2829	2904	2978	3053	3128	3203	3278	3353	75
580	3428	3503	3578	3653	3727	3802	3877	3952	4027	4101	
1	4176	4251	4326	4400	4475	4550	4624	4699	4774	4848	
2	4923	4998	5072	5147	5221	5296	5370	5445	5520	5594	
3	5669	5743	5818	5892	5966	6041	6115	6190	6264	6338	
4	6413	6487	6562	6636	6710	6785	6859	6933	7007	7082	

Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
83	8.3	16.6	24.9	33.2	41.5	49.8	58.1	66.4	74.7
82	8.2	16.4	24.6	32.8	41.0	49.2	57.4	65.6	73.8
81	8.1	16.2	24.3	32.4	40.5	48.6	56.7	64.8	72.9
80	8.0	16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0
79	7.9	15.8	23.7	31.6	39.5	47.4	55.3	63.2	71.1
78	7.8	15.6	23.4	31.2	39.0	46.8	54.6	62.4	70.2
77	7.7	15.4	23.1	30.8	38.5	46.2	53.9	61.6	69.3
76	7.6	15.2	22.8	30.4	38.0	45.6	53.2	60.8	68.4
75	7.5	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5
74	7.4	14.8	22.2	29.6	37.0	44.4	51.8	59.2	66.6

No. 585 L. 767.] [No. 629 L. 799.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
585	767156	7230	7304	7379	7453	7527	7601	7675	7749	7823	
6	7898	7972	8046	8120	8194	8268	8342	8416	8490	8564	74
7	8638	8712	8786	8860	8934	9008	9082	9156	9230	9303	
8	9377	9451	9525	9599	9673	9746	9820	9894	9968	0042	
9	770115	0189	0263	0336	0410	0484	0557	0631	0705	0778	
590	0852	0926	0999	1073	1146	1220	1293	1367	1440	1514	
1	1587	1661	1734	1808	1881	1955	2028	2102	2175	2248	
2	2322	2395	2468	2542	2615	2688	2762	2835	2908	2981	
3	3055	3128	3201	3274	3348	3421	3494	3567	3640	3713	
4	3786	3860	3933	4006	4079	4152	4225	4298	4371	4444	73
5	4517	4590	4663	4736	4809	4882	4955	5028	5100	5173	
6	5246	5319	5392	5465	5538	5610	5683	5756	5829	5902	
7	5974	6047	6120	6193	6265	6338	6411	6483	6556	6629	
8	6701	6774	6846	6919	6992	7064	7137	7209	7282	7354	
9	7427	7499	7572	7644	7717	7789	7862	7934	8006	8079	
600	8151	8224	8296	8368	8441	8513	8585	8658	8730	8802	
1	8874	8947	9019	9091	9163	9236	9308	9380	9452	9524	
2	9596	9669	9741	9813	9885	9957	0029	0101	0173	0245	
3	780317	0389	0461	0533	0605	0677	0749	0821	0893	0965	72
4	1037	1109	1181	1253	1324	1396	1468	1540	1612	1684	
5	1755	1827	1899	1971	2042	2114	2186	2258	2329	2401	
6	2473	2544	2616	2688	2759	2831	2902	2974	3046	3117	
7	3189	3260	3332	3403	3475	3546	3618	3689	3761	3832	
8	3904	3975	4046	4118	4189	4261	4332	4403	4475	4546	
9	4617	4689	4760	4831	4902	4974	5045	5116	5187	5259	
610	5330	5401	5472	5543	5615	5686	5757	5828	5899	5970	
1	6041	6112	6183	6254	6325	6396	6467	6538	6609	6680	71
2	6751	6822	6893	6964	7035	7106	7177	7248	7319	7390	
3	7460	7531	7602	7673	7744	7815	7885	7956	8027	8098	
4	8168	8239	8310	8381	8451	8522	8593	8663	8734	8804	
5	8875	8946	9016	9087	9157	9228	9299	9369	9440	9510	
6	9581	9651	9722	9792	9863	9933	0004	0074	0144	0215	
7	790285	0356	0426	0496	0567	0637	0707	0778	0848	0918	
8	0988	1059	1129	1199	1269	1340	1410	1480	1550	1620	
9	1691	1761	1831	1901	1971	2041	2111	2181	2252	2322	
620	2392	2462	2532	2602	2672	2742	2812	2882	2952	3022	70
1	3092	3162	3231	3301	3371	3441	3511	3581	3651	3721	
2	3790	3860	3930	4000	4070	4139	4209	4279	4349	4418	
3	4488	4558	4627	4697	4767	4836	4906	4976	5045	5115	
4	5185	5254	5324	5393	5463	5532	5602	5672	5741	5811	
5	5880	5949	6019	6088	6158	6227	6297	6366	6436	6505	
6	6574	6644	6713	6782	6852	6921	6990	7060	7129	7198	
7	7268	7337	7406	7475	7545	7614	7683	7752	7821	7890	
8	7960	8029	8098	8167	8236	8305	8374	8443	8513	8582	
9	8651	8720	8789	8858	8927	8996	9065	9134	9203	9272	69

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
75	7.5	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5
74	7.4	14.8	22.2	29.6	37.0	44.4	51.8	59.2	66.6
73	7.3	14.6	21.9	29.2	36.5	43.8	51.1	58.4	65.7
72	7.2	14.4	21.6	28.8	36.0	43.2	50.4	57.6	64.8
71	7.1	14.2	21.3	28.4	35.5	42.6	49.7	56.8	63.9
70	7.0	14.0	21.0	28.0	35.0	42.0	49.0	56.0	63.0
69	6.9	13.8	20.7	27.6	34.5	41.4	48.3	55.2	62.1

N.	0	1	2	3	4	5	6	7	8	9	Diff.
630	799341	9409	9478	9547	9616	9685	9754	9823	9892	9961	
1	800029	0098	0167	0236	0305	0373	0442	0511	0580	0648	
2	0717	0786	0854	0923	0992	1061	1129	1198	1266	1335	
3	1404	1472	1541	1609	1678	1747	1815	1884	1952	2021	
4	2089	2158	2226	2295	2363	2432	2500	2568	2637	2705	
5	2774	2842	2910	2979	3047	3116	3184	3252	3321	3389	
6	3457	3525	3594	3662	3730	3798	3867	3935	4003	4071	
7	4139	4208	4276	4344	4412	4480	4548	4616	4685	4753	
8	4821	4889	4957	5025	5093	5161	5229	5297	5365	5433	68
9	5501	5569	5637	5705	5773	5841	5908	5976	6044	6112	
640	806180	6248	6316	6384	6451	6519	6587	6655	6723	6790	
1	6858	6926	6994	7061	7129	7197	7264	7332	7400	7467	
2	7535	7603	7670	7738	7806	7873	7941	8008	8076	8143	
3	8211	8279	8346	8414	8481	8549	8616	8684	8751	8818	
4	8886	8953	9021	9088	9156	9223	9290	9358	9425	9492	
5	9560	9627	9694	9762	9829	9896	9964	0031	0098	0165	
6	810233	0300	0367	0434	0501	0569	0636	0703	0770	0837	
7	0904	0971	1039	1106	1173	1240	1307	1374	1441	1508	67
8	1575	1642	1709	1776	1843	1910	1977	2044	2111	2178	
9	2245	2312	2379	2445	2512	2579	2646	2713	2780	2847	
650	2913	2980	3047	3114	3181	3247	3314	3381	3448	3514	
1	3581	3648	3714	3781	3848	3914	3981	4048	4114	4181	
2	4248	4314	4381	4447	4514	4581	4647	4714	4780	4847	
3	4913	4980	5046	5113	5179	5246	5312	5378	5445	5511	
4	5578	5644	5711	5777	5843	5910	5976	6042	6109	6175	
5	6241	6308	6374	6440	6506	6573	6639	6705	6771	6838	
6	6904	6970	7036	7102	7169	7235	7301	7367	7433	7499	
7	7565	7631	7698	7764	7830	7896	7962	8028	8094	8160	
8	8226	8292	8358	8424	8490	8556	8622	8688	8754	8820	
9	8885	8951	9017	9083	9149	9215	9281	9346	9412	9478	66
660	9544	9610	9676	9741	9807	9873	9939	0004	0070	0136	
1	820201	0267	0333	0399	0464	0530	0595	0661	0727	0792	
2	0858	0924	0989	1055	1120	1186	1251	1317	1382	1448	
3	1514	1579	1645	1710	1775	1841	1906	1972	2037	2103	
4	2168	2233	2299	2364	2430	2495	2560	2626	2691	2756	
5	2822	2887	2952	3018	3083	3148	3213	3279	3344	3409	
6	3474	3539	3605	3670	3735	3800	3865	3930	3996	4061	
7	4126	4191	4256	4321	4386	4451	4516	4581	4646	4711	
8	4776	4841	4906	4971	5036	5101	5166	5231	5296	5361	65
9	5426	5491	5556	5621	5686	5751	5815	5880	5945	6010	
670	6075	6140	6204	6269	6334	6399	6464	6528	6593	6658	
1	6723	6787	6852	6917	6981	7046	7111	7175	7240	7305	
2	7369	7434	7499	7563	7628	7692	7757	7821	7886	7951	
3	8015	8080	8144	8209	8273	8338	8402	8467	8531	8595	
4	8660	8724	8789	8853	8918	8982	9046	9111	9175	9239	

PROPORTIONAL PARTS.

Diff	1	2	3	4	5	6	7	8	9
68	6 8	13 6	20 4	27 2	34 0	40 8	47 6	54 4	61 2
67	6 7	13 4	20.1	26 8	33 5	40 2	46 9	53 6	60 3
66	6 6	13.2	19 8	26.4	33 0	39 6	46 2	52 8	59 4
65	6.5	13 0	19.5	26 0	32.5	39 0	45 5	52 0	58 5
64	6.4	12.8	19.2	25 6	32.0	38.4	44 8	51 2	57.6

No. 675 L. 829.] [No. 719 L. 857.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
675	829304	9368	9432	9497	9561	9625	9690	9754	9818	9882	
6	9947	0011	0075	0139	0204	0268	0332	0396	0460	0525	
7	830589	0653	0717	0781	0845	0909	0973	1037	1102	1166	
8	1230	1294	1358	1422	1486	1550	1614	1678	1742	1806	64
9	1870	1934	1998	2062	2126	2189	2253	2317	2381	2445	
680	2509	2573	2637	2700	2764	2828	2892	2956	3020	3083	
1	3147	3211	3275	3338	3402	3466	3530	3593	3657	3721	
2	3784	3848	3912	3975	4039	4103	4166	4230	4294	4357	
3	4421	4484	4548	4611	4675	4739	4802	4866	4929	4993	
4	5056	5120	5183	5247	5310	5373	5437	5500	5564	5627	
5	5691	5754	5817	5881	5944	6007	6071	6134	6197	6261	
6	6324	6387	6451	6514	6577	6641	6704	6767	6830	6894	
7	6957	7020	7083	7146	7210	7273	7336	7399	7462	7525	
8	7588	7652	7715	7778	7841	7904	7967	8030	8093	8156	
9	8219	8282	8345	8408	8471	8534	8597	8660	8723	8786	63
690	8849	8912	8975	9038	9101	9164	9227	9289	9352	9415	
1	9478	9541	9604	9667	9729	9792	9855	9918	9981	0043	
2	840106	0169	0232	0294	0357	0420	0482	0545	0608	0671	
3	0733	0796	0859	0921	0984	1046	1109	1172	1234	1297	
4	1359	1422	1485	1547	1610	1672	1735	1797	1860	1922	
5	1985	2047	2110	2172	2235	2297	2360	2422	2484	2547	
6	2609	2672	2734	2796	2859	2921	2983	3046	3108	3170	
7	3233	3295	3357	3420	3482	3544	3606	3669	3731	3793	
8	3855	3918	3980	4042	4104	4166	4229	4291	4353	4415	
9	4477	4539	4601	4664	4726	4788	4850	4912	4974	5036	
700	5098	5160	5222	5284	5346	5408	5470	5532	5594	5656	62
1	5718	5780	5842	5904	5966	6028	6090	6151	6213	6275	
2	6337	6399	6461	6523	6585	6646	6708	6770	6832	6894	
3	6955	7017	7079	7141	7202	7264	7326	7388	7449	7511	
4	7573	7634	7696	7758	7819	7881	7943	8004	8066	8128	
5	8189	8251	8312	8374	8435	8497	8559	8620	8682	8743	
6	8805	8866	8928	8989	9051	9112	9174	9235	9297	9358	
7	9419	9481	9542	9604	9665	9726	9788	9849	9911	9972	
8	850033	0095	0156	0217	0279	0340	0401	0462	0524	0585	
9	0646	0707	0769	0830	0891	0952	1014	1075	1136	1197	
710	1258	1320	1381	1442	1503	1564	1625	1686	1747	1809	
1	1870	1931	1992	2053	2114	2175	2236	2297	2358	2419	61
2	2480	2541	2602	2663	2724	2785	2846	2907	2968	3029	
3	3090	3150	3211	3272	3333	3394	3455	3516	3577	3637	
4	3698	3759	3820	3881	3941	4002	4063	4124	4185	4245	
5	4306	4367	4428	4488	4549	4610	4670	4731	4792	4852	
6	4913	4974	5034	5095	5156	5216	5277	5337	5398	5459	
7	5519	5580	5640	5701	5761	5822	5882	5943	6003	6064	
8	6124	6185	6245	6306	6366	6427	6487	6548	6608	6668	
9	6729	6789	6850	6910	6970	7031	7091	7152	7212	7272	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
65	6.5	13.0	19.5	26.0	32.5	39.0	45.5	52.0	58.5
64	6.4	12.8	19.2	25.6	32.0	38.4	44.8	51.2	57.6
63	6.3	12.6	18.9	25.2	31.5	37.8	44.1	50.4	56.7
62	6.2	12.4	18.6	24.8	31.0	37.2	43.4	49.6	55.8
61	6.1	12.2	18.3	24.4	30.5	36.6	42.7	48.8	54.9
60	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0

No. 720 L. 857.] [No. 764 L. 883.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
720	857332	7393	7453	7513	7574	7634	7694	7755	7815	7875	
1	7935	7995	8056	8116	8176	8236	8297	8357	8417	8477	
2	8537	8597	8657	8718	8778	8838	8898	8958	9018	9078	
3	9138	9198	9258	9318	9379	9439	9499	9559	9619	9679	60
4	9739	9799	9859	9918	9978	0038	0098	0158	0218	0278	
5	860338	0398	0458	0518	0578	0637	0697	0757	0817	0877	
6	0937	0996	1056	1116	1176	1236	1295	1355	1415	1475	
7	1534	1594	1654	1714	1773	1833	1893	1952	2012	2072	
8	2131	2191	2251	2310	2370	2430	2439	2549	2608	2668	
9	2728	2787	2847	2906	2966	3025	3085	3144	3204	3263	
730	3323	3382	3442	3501	3561	3620	3680	3739	3799	3858	
1	3917	3977	4036	4096	4155	4214	4274	4333	4392	4452	
2	4511	4570	4630	4689	4748	4808	4867	4926	4985	5045	
3	5104	5163	5222	5282	5341	5400	5459	5519	5578	5637	
4	5696	5755	5814	5874	5933	5992	6051	6110	6169	6228	
5	6287	6346	6405	6465	6524	6583	6642	6701	6760	6819	
6	6878	6937	6996	7055	7114	7173	7232	7291	7350	7409	59
7	7467	7526	7585	7644	7703	7762	7821	7880	7939	7998	
8	8056	8115	8174	8233	8292	8350	8409	8468	8527	8586	
9	8644	8703	8762	8821	8879	8938	8997	9056	9114	9173	
740	9232	9290	9349	9408	9466	9525	9584	9642	9701	9760	
1	9818	9877	9935	9994	0053	0111	0170	0228	0287	0345	
2	870404	0462	0521	0579	0638	0696	0755	0813	0872	0930	
3	0989	1047	1106	1164	1223	1281	1339	1398	1456	1515	
4	1573	1631	1690	1748	1806	1865	1923	1981	2040	2008	
5	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	
6	2739	2797	2855	2913	2972	3030	3088	3146	3204	3262	
7	3321	3379	3437	3495	3553	3611	3669	3727	3785	3844	
8	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	58
9	4482	4540	4598	4656	4714	4772	4830	4888	4945	5003	
750	5061	5119	5177	5235	5293	5351	5409	5466	5524	5582	
1	5640	5698	5756	5813	5871	5929	5987	6045	6102	6160	
2	6218	6276	6333	6391	6449	6507	6564	6622	6680	6737	
3	6795	6853	6910	6968	7026	7083	7141	7199	7256	7314	
4	7371	7429	7487	7544	7602	7659	7717	7774	7832	7889	
5	7947	8004	8062	8119	8177	8234	8292	8349	8407	8464	
6	8522	8579	8637	8694	8752	8809	8866	8924	8981	9039	
7	9096	9153	9211	9268	9325	9383	9440	9497	9555	9612	
8	9669	9726	9784	9841	9898	9956	0013	0070	0127	0185	
9	880242	0299	0356	0413	0471	0528	0585	0642	0699	0756	
760	0814	0871	0928	0985	1042	1099	1156	1213	1271	1328	
1	1385	1442	1499	1556	1613	1670	1727	1784	1841	1898	57
2	1955	2012	2069	2126	2183	2240	2297	2354	2411	2468	
3	2525	2581	2638	2695	2752	2809	2866	2923	2980	3037	
4	3093	3150	3207	3264	3321	3377	3434	3491	3548	3605	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
59	5.9	11.8	17.7	23.6	29.5	35.4	41.3	47.2	53.1
58	5.8	11.6	17.4	23.2	29.0	34.8	40.6	46.4	52.2
57	5.7	11.4	17.1	22.8	28.5	34.2	39.9	45.6	51.3
56	5.6	11.2	16.8	22.4	28.0	33.6	39.2	44.8	50.4

No. 765 L. 883.] [No. 809 L. 908.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
765	883661	3718	3775	3832	3888	3945	4002	4059	4115	4172	
6	4229	4285	4342	4399	4455	4512	4569	4625	4682	4739	
7	4795	4852	4909	4965	5022	5078	5135	5192	5248	5305	
8	5361	5418	5474	5531	5587	5644	5700	5757	5813	5870	
9	5926	5983	6039	6096	6152	6209	6265	6321	6378	6434	
770	6491	6547	6604	6660	6716	6773	6829	6885	6942	6998	
1	7054	7111	7167	7223	7280	7336	7392	7449	7505	7561	
2	7617	7674	7730	7786	7842	7898	7955	8011	8067	8123	
3	8179	8236	8292	8348	8404	8460	8516	8573	8629	8685	
4	8741	8797	8853	8909	8965	9021	9077	9134	9190	9246	
5	9302	9358	9414	9470	9526	9582	9638	9694	9750	9806	56
6	9862	9918	9974	0030	0086	0141	0197	0253	0309	0365	
7	890421	0477	0533	0589	0645	0700	0756	0812	0868	0924	
8	0980	1035	1091	1147	1203	1259	1314	1370	1426	1482	
9	1537	1593	1649	1705	1760	1816	1872	1928	1983	2039	
780	2095	2150	2206	2262	2317	2373	2429	2484	2540	2595	
1	2651	2707	2762	2818	2873	2929	2985	3040	3096	3151	
2	3207	3262	3318	3373	3429	3484	3540	3595	3651	3706	
3	3762	3817	3873	3928	3984	4039	4094	4150	4205	4261	
4	4316	4371	4427	4482	4538	4593	4648	4704	4759	4814	
5	4870	4925	4980	5036	5091	5146	5201	5257	5312	5367	
6	5423	5478	5533	5588	5644	5699	5754	5809	5864	5920	
7	5975	6030	6085	6140	6195	6251	6306	6361	6416	6471	
8	6526	6581	6636	6692	6747	6802	6857	6912	6967	7022	
9	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	55
790	7627	7682	7737	7792	7847	7902	7957	8012	8067	8122	
1	8176	8231	8286	8341	8396	8451	8506	8561	8615	8670	
2	8725	8780	8835	8890	8944	8999	9054	9109	9164	9218	
3	9273	9328	9383	9437	9492	9547	9602	9656	9711	9766	
4	9821	9875	9930	9985	0039	0094	0149	0203	0258	0312	
5	900367	0422	0476	0531	0586	0640	0695	0749	0804	0859	
6	0913	0968	1022	1077	1131	1186	1240	1295	1349	1404	
7	1458	1513	1567	1622	1676	1731	1785	1840	1894	1948	
8	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	
9	2547	2601	2655	2710	2764	2818	2873	2927	2981	3036	
800	3090	3144	3199	3253	3307	3361	3416	3470	3524	3578	
1	3633	3687	3741	3795	3849	3904	3958	4012	4066	4120	
2	4174	4229	4283	4337	4391	4445	4499	4553	4607	4661	
3	4716	4770	4824	4878	4932	4986	5040	5094	5148	5202	54
4	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	
5	5796	5850	5904	5958	6012	6066	6119	6173	6227	6281	
6	6335	6389	6443	6497	6551	6604	6658	6712	6766	6820	
7	6874	6927	6981	7035	7089	7143	7196	7250	7304	7358	
8	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	
9	7949	8002	8056	8110	8163	8217	8270	8324	8378	8431	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
57	5.7	11.4	17.1	22.8	28.5	34.2	39.9	45.6	51.3
56	5.6	11.2	16.8	22.4	28.0	33.6	39.2	44.8	50.4
55	5.5	11.0	16.5	22.0	27.5	33.0	38.5	44.0	49.5
54	5.4	10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6

No. 810 L. 908.] [No. 854 L. 931.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
810	908485	8539	8592	8646	8699	8753	8807	8860	8914	8967	
1	9021	9074	9128	9181	9235	9289	9342	9396	9449	9503	
2	9556	9610	9663	9716	9770	9823	9877	9930	9984	0037	
3	910091	0144	0197	0251	0304	0358	0411	0464	0518	0571	
4	0624	0678	0731	0784	0838	0891	0944	0998	1051	1104	
5	1158	1211	1264	1317	1371	1424	1477	1530	1584	1637	
6	1690	1743	1797	1850	1903	1956	2009	2063	2116	2169	
7	2222	2275	2328	2381	2435	2488	2541	2594	2647	2700	
8	2753	2806	2859	2913	2966	3019	3072	3125	3178	3231	
9	3284	3337	3390	3443	3496	3549	3602	3655	3708	3761	53
820	3814	3867	3920	3973	4026	4079	4132	4184	4237	4290	
1	4343	4396	4449	4502	4555	4608	4660	4713	4766	4819	
2	4872	4925	4977	5030	5083	5136	5189	5241	5294	5347	
3	5400	5453	5505	5558	5611	5664	5716	5769	5822	5875	
4	5927	5980	6033	6085	6138	6191	6243	6296	6349	6401	
5	6454	6507	6559	6612	6664	6717	6770	6822	6875	6927	
6	6980	7033	7085	7138	7190	7243	7295	7348	7400	7453	
7	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	
8	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	
9	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	
830	9078	9130	9183	9235	9287	9340	9392	9444	9496	9549	
1	9601	9653	9706	9758	9810	9862	9914	9967	0019	0071	
2	920123	0176	0228	0280	0332	0384	0436	0489	0541	0593	
3	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	
4	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	52
5	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	
6	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	
7	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	
8	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	
9	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	
840	4279	4331	4383	4434	4486	4538	4589	4641	4693	4744	
1	4796	4848	4899	4951	5003	5054	5106	5157	5209	5261	
2	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	
3	5828	5879	5931	5982	6034	6085	6137	6188	6240	6291	
4	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	
5	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	
6	7370	7422	7473	7524	7576	7627	7678	7730	7781	7832	
7	7883	7935	7986	8037	8088	8140	8191	8242	8293	8345	
8	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	
9	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	
850	9419	9470	9521	9572	9623	9674	9725	9776	9827	9879	
1	9930	9981	0032	0083	0134	0185	0236	0287	0338	0389	51
2	930440	0491	0542	0592	0643	0694	0745	0796	0847	0898	
3	0949	1000	1051	1102	1153	1204	1254	1305	1356	1407	
4	1458	1509	1560	1610	1661	1712	1763	1814	1865	1915	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
53	5.3	10.6	15.9	21.2	26.5	31.8	37.1	42.4	47.7
52	5.2	10.4	15.6	20.8	26.0	31.2	36.4	41.6	46.8
51	5.1	10.2	15.3	20.4	25.5	30.6	35.7	40.8	45.9
50	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0

No. 855 L. 931.] [No. 899 L. 954.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
855	931966	2017	2068	2118	2169	2220	2271	2322	2372	2423	
6	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	
7	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	
8	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	
9	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	
860	4498	4549	4599	4650	4700	4751	4801	4852	4902	4953	
1	5003	5054	5104	5154	5205	5255	5306	5356	5406	5457	
2	5507	5558	5608	5658	5709	5759	5809	5860	5910	5960	
3	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	
4	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	
5	7016	7066	7116	7167	7217	7267	7317	7367	7418	7468	
6	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	
7	8019	8069	8119	8169	8219	8269	8320	8370	8420	8470	50
8	8520	8570	8620	8670	8720	8770	8820	8870	8920	8970	
9	9020	9070	9120	9170	9220	9270	9320	9369	9419	9469	
870	9519	9569	9619	9669	9719	9769	9819	9869	9918	9968	
1	940018	0068	0118	0168	0218	0267	0317	0367	0417	0467	
2	0516	0566	0616	0666	0716	0765	0815	0865	0915	0964	
3	1014	1064	1114	1163	1213	1263	1313	1362	1412	1462	
4	1511	1561	1611	1660	1710	1760	1809	1859	1909	1958	
5	2008	2058	2107	2157	2207	2256	2306	2355	2405	2455	
6	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	
7	3000	3049	3099	3148	3198	3247	3297	3346	3396	3445	
8	3495	3544	3593	3643	3692	3742	3791	3841	3890	3939	
9	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	
880	4483	4532	4581	4631	4680	4729	4779	4828	4877	4927	
1	4976	5025	5074	5124	5173	5222	5272	5321	5370	5419	
2	5469	5518	5567	5616	5665	5715	5764	5813	5862	5912	
3	5961	6010	6059	6108	6157	6207	6256	6305	6354	6403	
4	6452	6501	6551	6600	6649	6698	6747	6796	6845	6894	
5	6943	6992	7041	7090	7139	7189	7238	7287	7336	7385	
6	7434	7483	7532	7581	7630	7679	7728	7777	7826	7875	49
7	7924	7973	8022	8070	8119	8168	8217	8266	8315	8364	
8	8413	8462	8511	8560	8608	8657	8706	8755	8804	8853	
9	8902	8951	8999	9048	9097	9146	9195	9244	9292	9341	
890	9390	9439	9488	9536	9585	9634	9683	9731	9780	9829	
1	9878	9926	9975	0024	0073	0121	0170	0219	0267	0316	
2	950365	0414	0462	0511	0560	0608	0657	0706	0754	0803	
3	0851	0900	0949	0997	1046	1095	1143	1192	1240	1289	
4	1338	1386	1435	1483	1532	1580	1629	1677	1726	1775	
5	1823	1872	1920	1969	2017	2066	2114	2163	2211	2260	
6	2308	2356	2405	2453	2502	2550	2599	2647	2696	2744	
7	2792	2841	2889	2938	2986	3034	3083	3131	3180	3228	
8	3276	3325	3373	3421	3470	3518	3566	3615	3663	3711	
9	3760	3808	3856	3905	3953	4001	4049	4098	4146	4194	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
51	5.1	10.2	15.3	20.4	25.5	30.6	35.7	40.8	45.9
50	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0
49	4.9	9.8	14.7	19.6	24.5	29.4	34.3	39.2	44.1
48	4.8	9.6	14.4	19.2	24.0	28.8	33.6	38.4	43.2

No 900 L. 954.] [No. 944 L. 975.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
900	954243	4291	4339	4387	4435	4484	4532	4580	4628	4677	
1	4725	4773	4821	4869	4918	4966	5014	5062	5110	5158	
2	5207	5255	5303	5351	5399	5447	5495	5543	5592	5640	
3	5688	5736	5784	5832	5880	5928	5976	6024	6072	6120	
4	6168	6216	6265	6313	6361	6409	6457	6505	6553	6601	
5	6649	6697	6745	6793	6840	6888	6936	6984	7032	7080	48
6	7128	7176	7224	7272	7320	7368	7416	7464	7512	7559	
7	7607	7655	7703	7751	7799	7847	7894	7942	7990	8038	
8	8086	8134	8181	8229	8277	8325	8373	8421	8468	8516	
9	8564	8612	8659	8707	8755	8803	8850	8898	8946	8994	
910	9041	9089	9137	9185	9232	9280	9328	9375	9423	9471	
1	9518	9566	9614	9661	9709	9757	9804	9852	9900	9947	
2	9995	0042	0090	0138	0185	0233	0280	0328	0376	0423	
3	960471	0518	0566	0613	0661	0709	0756	0804	0851	0899	
4	0946	0994	1041	1089	1136	1184	1231	1279	1326	1374	
5	1421	1469	1516	1563	1611	1658	1706	1753	1801	1848	
6	1895	1943	1990	2038	2085	2132	2180	2227	2275	2322	
7	2369	2417	2464	2511	2559	2606	2653	2701	2748	2795	
8	2843	2890	2937	2985	3032	3079	3126	3174	3221	3268	
9	3316	3363	3410	3457	3504	3552	3599	3646	3693	3741	
920	3788	3835	3882	3929	3977	4024	4071	4118	4165	4212	
1	4260	4307	4354	4401	4448	4495	4542	4590	4637	4684	
2	4731	4778	4825	4872	4919	4966	5013	5061	5108	5155	
3	5202	5249	5296	5343	5390	5437	5484	5531	5578	5625	
4	5672	5719	5766	5813	5860	5907	5954	6001	6048	6095	47
5	6142	6189	6236	6283	6329	6376	6423	6470	6517	6564	
6	6611	6658	6705	6752	6799	6845	6892	6939	6986	7033	
7	7080	7127	7173	7220	7267	7314	7361	7408	7454	7501	
8	7548	7595	7642	7688	7735	7782	7829	7875	7922	7969	
9	8016	8062	8109	8156	8203	8249	8296	8343	8390	8436	
930	8483	8530	8576	8623	8670	8716	8763	8810	8856	8903	
1	8950	8996	9043	9090	9136	9183	9229	9276	9323	9369	
2	9416	9463	9509	9556	9602	9649	9695	9742	9789	9835	
3	9882	9928	9975	0021	0068	0114	0161	0207	0254	0300	
4	970347	0393	0440	0486	0533	0579	0626	0672	0719	0765	
5	0812	0858	0904	0951	0997	1044	1090	1137	1183	1229	
6	1276	1322	1369	1415	1461	1508	1554	1601	1647	1693	
7	1740	1786	1832	1879	1925	1971	2018	2064	2110	2157	
8	2203	2249	2295	2342	2388	2434	2481	2527	2573	2619	
9	2666	2712	2758	2804	2851	2897	2943	2989	3035	3082	
940	3128	3174	3220	3266	3313	3359	3405	3451	3497	3543	
1	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	
2	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	
3	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	46
4	4972	5018	5064	5110	5156	5202	5248	5294	5340	5386	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
47	4.7	9.4	14.1	18.8	23.5	28.2	32.9	37.6	42.3
46	4.6	9.2	13.8	18.4	23.0	27.6	32.2	36.8	41.4

No. 945 L. 975.] [No. 989 L. 995.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
945	975432	5478	5524	5570	5616	5662	5707	5753	5799	5845	
6	5891	5937	5983	6029	6075	6121	6167	6212	6258	6304	
7	6350	6396	6442	6488	6533	6579	6625	6671	6717	6763	
8	6808	6854	6900	6946	6992	7037	7083	7129	7175	7220	
9	7266	7312	7358	7403	7449	7495	7541	7586	7632	7678	
950	7724	7769	7815	7861	7906	7952	7998	8043	8089	8135	
1	8181	8226	8272	8317	8363	8409	8454	8500	8546	8591	
2	8637	8683	8728	8774	8819	8865	8911	8956	9002	9047	
3	9093	9138	9184	9230	9275	9321	9366	9412	9457	9503	
4	9548	9594	9639	9685	9730	9776	9821	9867	9912	9958	
5	980003	0049	0094	0140	0185	0231	0276	0322	0367	0412	
6	0458	0503	0549	0594	0640	0685	0730	0776	0821	0867	
7	0912	0957	1003	1048	1093	1139	1184	1229	1275	1320	
8	1366	1411	1456	1501	1547	1592	1637	1683	1728	1773	
9	1819	1864	1909	1954	2000	2045	2090	2135	2181	2226	
960	2271	2316	2362	2407	2452	2497	2543	2588	2633	2678	
1	2723	2769	2814	2859	2904	2949	2994	3040	3085	3130	
2	3175	3220	3265	3310	3356	3401	3446	3491	3536	3581	
3	3626	3671	3716	3762	3807	3852	3897	3942	3987	4032	
4	4077	4122	4167	4212	4257	4302	4347	4392	4437	4482	
5	4527	4572	4617	4662	4707	4752	4797	4842	4887	4932	45
6	4977	5022	5067	5112	5157	5202	5247	5292	5337	5382	
7	5426	5471	5516	5561	5606	5651	5696	5741	5786	5830	
8	5875	5920	5965	6010	6055	6100	6144	6189	6234	6279	
9	6324	6369	6413	6458	6503	6548	6593	6637	6682	6727	
970	6772	6817	6861	6906	6951	6996	7040	7085	7130	7175	
1	7219	7264	7309	7353	7398	7443	7488	7532	7577	7622	
2	7666	7711	7756	7800	7845	7890	7934	7979	8024	8068	
3	8113	8157	8202	8247	8291	8336	8381	8425	8470	8514	
4	8559	8604	8648	8693	8737	8782	8826	8871	8916	8960	
5	9005	9049	9094	9138	9183	9227	9272	9316	9361	9405	
6	9450	9494	9539	9583	9628	9672	9717	9761	9806	9850	
7	9895	9939	9983	0028	0072	0117	0161	0206	0250	0294	
8	990339	0383	0428	0472	0516	0561	0605	0650	0694	0738	
9	0783	0827	0871	0916	0960	1004	1049	1093	1137	1182	
980	1226	1270	1315	1359	1403	1448	1492	1536	1580	1625	
1	1669	1713	1758	1802	1846	1890	1935	1979	2023	2067	
2	2111	2156	2200	2244	2288	2333	2377	2421	2465	2509	
3	2554	2598	2642	2686	2730	2774	2819	2863	2907	2951	
4	2995	3039	3083	3127	3172	3216	3260	3304	3348	3392	
5	3436	3480	3524	3568	3613	3657	3701	3745	3789	3833	
6	3877	3921	3965	4009	4053	4097	4141	4185	4229	4273	
7	4317	4361	4405	4449	4493	4537	4581	4625	4669	4713	44
8	4757	4801	4845	4889	4933	4977	5021	5065	5108	5152	
9	5196	5240	5284	5328	5372	5416	5460	5504	5547	5591	

PROPORTIONAL PARTS.

Diff.	1	2	3	4	5	6	7	8	9
46	4.6	9.2	13.8	18.4	23.0	27.6	32.2	36.8	41.4
45	4.5	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5
44	4.4	8.8	13.2	17.6	22.0	26.4	30.8	35.2	39.6
43	4.3	8.6	12.9	17.2	21.5	25.8	30.1	34.4	38.7

No. 990 L. 995.] [No. 999 L. 999.

N.	0	1	2	3	4	5	6	7	8	9	Diff.
990	995635	5679	5723	5767	5811	5854	5898	5942	5986	6030	
1	6074	6117	6161	6205	6249	6293	6337	6380	6424	6468	44
2	6512	6555	6599	6643	6687	6731	6774	6818	6862	6906	
3	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	
4	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	
5	7823	7867	7910	7954	7998	8041	8085	8129	8172	8216	
6	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	
7	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	
8	9131	9174	9218	9261	9305	9348	9392	9435	9479	9522	
9	9565	9609	9652	9696	9739	9783	9826	9870	9913	9957	43

Logarithms of Numbers from 1 to 100.

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908485
2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
3	0.477121	23	1.361728	43	1.633468	63	1.799341	83	1.919078
4	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
5	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
9	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
10	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
13	1.113943	33	1.518514	53	1.724276	73	1.863323	93	1.968483
14	1.146128	34	1.531479	54	1.732394	74	1.869232	94	1.973128
15	1 176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
16	1.204120	36	1.556303	56	1.748188	76	1.880814	96	1.982271
17	1.230449	37	1.568202	57	1.755875	77	1.886491	97	1.986772
18	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20	1.301030	40	1.602060	60	1.778151	80	1.903090	100	2.000000

	Value at 0°.	Sign in 1st Quad.	Value at 90°.	Sign in 2d Quad.	Value at 180°.	Sign in 3d Quad.	Value at 270°	Sign in 4th Quad.	Value at 360°.
Sin........	O	+	R	+	O	−	R	−	O
Tan........	O	+	∞	−	O	+	∞.	−	O
Sec........	R	+	∞	−	R	−	∞	+	R
Versin....	O	+	R	+	2 R	+	R	+	O
Cos........	R	+	O	−	R	−	O	+	R
Cot.... ...	∞	+	O	−	∞	+	O	−	∞
Cosec.....	∞	+	R	+	∞	−	R	−	∞

R signifies equal to rad; ∞ signifies infinite; O signifies evanescent.

″	′	Sine.	q − l		Tang.	Cotang.	q + l	D 1″	Cosine.	′
			4.685				15.314			
0	0	Inf. neg.	575	575	Inf. neg.	Inf. pos.	425		ten	60
60	1	6.463726	575	575	6.463726	13.536274	425		ten	59
120	2	.764756	575	575	.764756	.235244	425		ten	58
180	3	6.940847	575	575	6.940847	13.059153	425		ten	57
240	4	7.065786	575	575	7.065786	12.934214	425		ten	56
300	5	.162696	575	575	.162696	.837304	425		ten	55
360	6	.241877	575	575	.241878	.758122	425	.02	9.999999	54
420	7	.308824	575	575	.308825	.691175	425	.00	.999999	53
480	8	.366816	574	576	.366817	.633183	424	.00	.999999	52
540	9	.417968	574	576	.417970	.582030	424	.00	.999999	51
600	10	.463726	574	576	.463727	.536273	424	.02	.999998	50
660	11	7.505118	574	576	7.505120	12.494880	424	.00	9.999998	49
720	12	.542906	574	577	.542909	.457091	423	.02	.999997	48
780	13	.577668	574	577	.577672	.422328	423	.00	.999997	47
840	14	.609853	574	577	.609857	.390143	423	.02	.999996	46
900	15	.639816	573	578	.639820	.360180	422	.00	.999996	45
960	16	.667845	573	578	.667849	.332151	422	.02	.999995	44
1020	17	.694173	573	578	.694179	.305821	422	.00	.999995	43
1080	18	.718997	573	579	.719003	.280997	421	.02	.999994	42
1140	19	.742478	573	579	.742484	.257516	421	.02	.999993	41
1200	20	.764754	572	580	.764761	.235239	420	.00	.999993	40
1260	21	7.785943	572	580	7.785951	12.214049	420	.02	9.999992	39
1320	22	.806146	572	581	.806155	.193845	419	.02	.999991	38
1380	23	.825451	572	581	.825460	.174540	419	.02	.999990	37
1440	24	.843934	571	582	.843944	.156056	418	.02	.999989	36
1500	25	.861662	571	583	.861674	.138326	417	.00	.999989	35
1560	26	.878695	571	583	.878708	.121292	417	.02	.999988	34
1620	27	.895085	570	584	.895099	.104901	416	.02	.999987	33
1680	28	.910879	570	584	.910894	.089106	416	.02	.999986	32
1740	29	.926119	570	585	.926134	.073866	415	.02	.999985	31
1800	30	.940842	569	586	.940858	.059142	414	.03	.999983	30
1860	31	7.955082	569	587	7.955100	12.044900	413	.02	9.999982	29
1920	32	.968870	569	587	.968889	.031111	413	.02	.999981	28
1980	33	.982233	568	588	.982253	.017747	412	.02	.999980	27
2040	34	7.995198	568	589	7.995219	12.004781	411	.02	.999979	26
2100	35	8.007787	567	590	8.007809	11.992191	410	.03	.999977	25
2160	36	.020021	567	591	.020044	.979956	409	.02	.999976	24
2220	37	.031919	566	592	.031945	.968055	408	.02	.999975	23
2280	38	.043501	566	593	.043527	.956473	407	.03	.999973	22
2340	39	.054781	566	593	.054809	.945191	407	.02	.999972	21
2400	40	.065776	565	594	.065806	.934194	406	.02	.999971	20
2460	41	8.076500	565	595	8.076531	11.923469	405	.03	9.999969	19
2520	42	.086965	564	596	.086997	.913003	404	.02	.999968	18
2580	43	.097183	564	598	.097217	.902783	402	.03	.999966	17
2640	44	.107167	563	599	.107203	.892797	401	.03	.999964	16
2700	45	.116926	562	600	.116963	.883037	400	.02	.999963	15
2760	46	.126471	562	601	.126510	.873490	399	.03	.999961	14
2820	47	.135810	561	602	.135851	.864149	398	.03	.999959	13
2880	48	.144953	561	603	.144996	.855004	397	.02	.999958	12
2940	49	.153907	560	604	.153952	.846048	396	.03	.999956	11
3000	50	.162681	560	605	.162727	.837273	395	.03	.999954	10
3060	51	8.171280	559	607	8.171328	11.828672	393	.03	9.999952	9
3120	52	.179713	558	608	.179763	.820237	392	.03	.999950	8
3180	53	.187985	558	609	.188036	.811964	391	.03	.999948	7
3240	54	.196102	557	611	.196156	.803844	389	.03	.999946	6
3300	55	.204070	556	612	.204126	.795874	388	.03	.999944	5
3360	56	.211895	556	613	.211953	.788047	387	.03	.999942	4
3420	57	.219581	555	615	.219641	.780359	385	.03	.999940	3
3480	58	.227134	554	616	.227195	.772805	384	.03	.999938	2
3540	59	.234557	554	618	.234621	.765379	382	.03	.999936	1
3600	60	8.241855	553	619	8.241921	11.758079	381	.03	9.999934	0
			4.685				15.314			
″	′	Cosine.	q − l		Cotang.	Tang.	q + l	D 1″	Sine.	′

″	′	Sine.	q − l		Tang.	Cotang.	q + l	D 1″	Cosine.	′
			4.685				15.314			
3600	0	8.241855	553	619	8.241921	11.758079	381	.03	9.999934	60
3660	1	.249033	552	620	.249102	.750898	380	.05	.999932	59
3720	2	.256094	551	622	.256165	.743835	378	.03	.999929	58
3780	3	.263042	551	623	.263115	.736885	377	.03	.999927	57
3840	4	.269881	550	625	.269956	.730044	375	.05	.999925	56
3900	5	.276614	549	627	.276691	.723309	373	.03	.999922	55
3960	6	.283243	548	628	.283323	.716677	372	.03	.999920	54
4020	7	.289773	547	630	.289856	.710144	370	.05	.999918	53
4080	8	.296207	546	632	.296292	.703708	368	.03	.999915	52
4140	9	.302546	546	633	.302634	.697366	367	.05	.999913	51
4200	10	.308794	545	635	.308884	.691116	365	.05	.999910	50
4260	11	8.314954	544	637	8.315046	11.684954	363	.03	9.999907	49
4320	12	.321027	543	638	.321122	.678878	362	.05	.999905	48
4380	13	.327016	542	640	.327114	.672886	360	.05	.999902	47
4440	14	.332924	541	642	.333025	.666975	358	.03	.999899	46
4500	15	.338753	540	644	.338856	.661144	356	.05	.999897	45
4560	16	.344504	539	646	.344610	.655390	354	.05	.999894	44
4620	17	.350181	539	648	.350289	.649711	352	.05	.999891	43
4680	18	.355783	538	649	.355895	.644105	351	.05	.999888	42
4740	19	.361315	537	651	.361430	.638570	349	.05	.999885	41
4800	20	.366777	536	653	.366895	.633105	347	.05	.999882	40
4860	21	8.372171	535	655	8.372292	11.627708	345	.05	9.999879	39
4920	22	.377499	534	657	.377622	.622378	343	.05	.999876	38
4980	23	.382762	533	659	.382889	.617111	341	.05	.999873	37
5040	24	.387962	532	661	.388092	.611908	339	.05	.999870	36
5100	25	.393101	531	663	.393234	.606766	337	.05	.999867	35
5160	26	.398179	530	666	.398315	.601685	334	.05	.999864	34
5220	27	.403199	529	668	.403338	.596662	332	.05	.999861	33
5280	28	.408161	527	670	.408304	.591696	330	.07	.999858	32
5340	29	.413068	526	672	.413213	.586787	328	.05	.999854	31
5400	30	.417919	525	674	.418068	.581932	326	.05	.999851	30
5460	31	8.422717	524	676	8.422869	11.577131	324	.07	9.999848	29
5520	32	.427462	523	679	.427618	.572382	321	.05	.999844	28
5580	33	.432156	522	681	.432315	.567685	319	.05	.999841	27
5640	34	.436800	521	683	.436962	.563038	317	.07	.999838	26
5700	35	.441394	520	685	.441560	.558440	315	.05	.999834	25
5760	36	.445941	518	688	.446110	.553890	312	.07	.999831	24
5820	37	.450440	517	690	.450613	.549387	310	.05	.999827	23
5880	38	.454893	516	693	.455070	.544930	307	.07	.999824	22
5940	39	.459301	515	695	.459481	.540519	305	.07	.999820	21
6000	40	.463665	514	697	.463849	.536151	303	.05	.999816	20
6060	41	8.467985	512	700	8.468172	11.531828	300	.07	9.999813	19
6120	42	.472263	511	702	.472454	.527546	298	.07	.999809	18
6180	43	.476498	510	705	.476693	.523307	295	.07	.999805	17
6240	44	.480693	509	707	.480892	.519108	293	.07	.999801	16
6300	45	.484848	507	710	.485050	.514950	290	.05	.999797	15
6360	46	.488963	506	713	.489170	.510830	287	.07	.999794	14
6420	47	.493040	505	715	.493250	.506750	285	.07	.999790	13
6480	48	.497078	503	718	.497293	.502707	282	.07	.999786	12
6540	49	.501080	502	720	.501298	.498702	280	.07	.999782	11
6600	50	.505045	501	723	.505267	.494733	277	.07	.999778	10
6660	51	8.508974	499	726	8.509200	11.490800	274	.08	9.999774	9
6720	52	.512867	498	729	.513098	.486902	271	.07	.999769	8
6780	53	.516726	497	731	.516961	.483039	269	.07	.999765	7
6840	54	.520551	495	734	.520790	.479210	266	.07	.999761	6
6900	55	.524343	494	737	524586	.475414	263	.07	.999757	5
6960	56	.528102	492	740	.528349	.471651	260	.08	.999753	4
7020	57	.531828	491	743	.532080	.467920	257	.07	.999748	3
7080	58	.535523	490	745	.535779	.464221	255	.07	.999744	2
7140	59	.539186	488	748	.539447	.460553	252	.08	.999740	1
7200	60	8.542819	487	751	8.543084	11.456916	249		9.999735	0
			4.685				15.314			
″	′	Cosine.	q − l		Cotang.	Tang.	q + l	D 1″	Sine.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	8 542319	60.05	9.999735	.07	8.543084	60.12	11.456916	60
1	.546422	59.55	.999731	.08	.546691	59.62	.453309	59
2	.549995	59.07	.999726	.07	.550268	59.15	.449732	58
3	.553539	58.58	.999722	.08	.553817	58.65	.446183	57
4	.557054	58.10	.999717	.07	.557336	58.20	.442664	56
5	.560540	57.65	.999713	.08	.560828	57.72	.439172	55
6	.563999	57.20	.999708	.07	.564291	57.27	.435709	54
7	.567431	56.75	.999704	.08	.567727	56.83	.432273	53
8	.570836	56.30	.999699	.08	.571137	56.38	.428863	52
9	.574214	55.87	.999694	.08	.574520	55.95	.425480	51
10	.577566	55.43	.999689	.07	.577877	55.52	.422123	50
11	8.580892	55.02	9.999685	.08	8.581208	55.10	11.418792	49
12	.584193	54.60	.999680	.08	.584514	54.68	.415486	48
13	.587469	54.20	.999675	.08	.587795	54.27	.412205	47
14	.590721	53.78	.999670	.08	.591051	53.87	.408949	46
15	.593948	53.40	.999665	.08	.594283	53.48	.405717	45
16	.597152	53.00	.999660	.08	.597492	53.08	.402508	44
17	.600332	52.62	.999655	.08	.600677	52.70	.399323	43
18	.603489	52.23	.999650	.08	.603839	52.32	.396161	42
19	.606623	51.85	.999645	.08	.606978	51.93	.393022	41
20	.609734	51.48	.999640	.08	.610094	51.58	.389906	40
21	8.612823	51.13	9.999635	.10	8.613189	51.22	11.386811	39
22	.615891	50.77	.999629	.08	.616262	50.85	.383738	38
23	.618937	50.42	.999624	.08	.619313	50.50	.380687	37
24	.621962	50.05	.999619	.08	.622343	50.15	.377657	36
25	.624965	49.72	.999614	.10	.625352	49.80	.374648	35
26	.627948	49.38	.999608	.08	.628340	49.47	.371660	34
27	.630911	49.05	.999603	.10	.631308	49.13	.368692	33
28	.633854	48.70	.999597	.08	.634256	48.80	.365744	32
29	.636776	48.40	.999592	.10	.637184	48.48	.362816	31
30	.639680	48.05	.999586	.08	.640093	48.15	.359907	30
31	8.642563	47.75	9.999581	.10	8.642982	47.85	11.357018	29
32	.645428	47.43	.999575	.08	.645853	47.52	.354147	28
33	.648274	47.13	.999570	.10	.648704	47.22	.351296	27
34	.651102	46.82	.999564	.10	.651537	46.92	.348463	26
35	.653911	46.52	.999558	.08	.654352	46.62	.345648	25
36	.656702	46.22	.999553	.10	.657149	46.32	.342851	24
37	.659475	45.92	.999547	.10	.659928	46.02	.340072	23
38	.662230	45.63	.999541	.10	.662689	45.73	.337311	22
39	.664968	45.35	.999535	.10	.665433	45.45	.334567	21
40	.667689	45.07	.999529	.08	.668160	45.17	.331840	20
41	8.670393	44.78	9.999524	.10	8.670870	44.88	11.329130	19
42	.673080	44.52	.999518	.10	.673563	44.60	.326437	18
43	.675751	44.23	.999512	.10	.676239	44.35	.323761	17
44	.678405	43.97	.999506	.10	.678900	44.07	.321100	16
45	.681043	43.70	.999500	.12	.681544	43.80	.318456	15
46	.683665	43.45	.999493	.10	.684172	43.53	.315828	14
47	.686272	43.18	.999487	.10	.686784	43.28	.313216	13
48	.688863	42.92	.999481	.10	.689381	43.03	.310619	12
49	.691438	42.67	.999475	.10	.691963	42.77	.308037	11
50	.693998	42.42	.999469	.10	.694529	42.53	.305471	10
51	8.696543	42.17	9.999463	.12	8.697081	42.27	11.302919	9
52	.699073	41.93	.999456	.10	.699617	42.03	.300383	8
53	.701589	41.68	.999450	.12	.702139	41.78	.297861	7
54	.704090	41.45	.999443	.10	.704646	41.57	.295354	6
55	.706577	41.20	.999437	.10	.707140	41.30	.292860	5
56	.709049	40.97	.999431	.12	.709618	41.08	.290382	4
57	.711507	40.75	.999424	.10	.712083	40.85	.287917	3
58	.713952	40.52	.999418	.12	.714534	40.63	.285466	2
59	.716383	40.28	.999411	.12	.716972	40.40	.283028	1
60	8.718800		9.999404		8.719396		11.280604	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	8.718800	40.07	9.999404	.10	8.719396	40.17	11.280604	60
1	.721204	39.85	.999398	.12	.721806	39.97	.278194	59
2	.723595	39.62	.999391	.12	.724204	39.73	.275796	58
3	.725972	39.42	.999384	.10	.726588	39.52	.273412	57
4	.728337	39.18	.999378	.12	.728959	39.30	.271041	56
5	.730688	38.98	.999371	.12	.731317	39.10	.268683	55
6	.733027	38.78	.999364	.12	.733663	38.88	.266337	54
7	.735354	38.55	.999357	.12	.735996	38.68	.264004	53
8	.737667	38.37	.999350	.12	.738317	38.48	.261683	52
9	.739969	38.17	.999343	.12	.740626	38.27	.259374	51
10	.742259	37.95	.999336	.12	.742922	38.08	.257078	50
11	8.744536	37.77	9.999329	.12	8.745207	37.87	11.254793	49
12	.746802	37.55	.999322	.12	.747479	37.68	.252521	48
13	.749055	37.37	.999315	.12	.749740	37.48	.250260	47
14	.751297	37.18	.999308	.12	.751989	37.30	.248011	46
15	.753528	36.98	.999301	.12	.754227	37.10	.245773	45
16	.755747	36.80	.999294	.12	.756453	36.92	.243547	44
17	.757955	36.60	.999287	.13	.758668	36.73	.241332	43
18	.760151	36.43	.999279	.12	.760872	36.55	.239128	42
19	.762337	36.23	.999272	.12	.763065	36.35	.236935	41
20	.764511	36.07	.999265	.13	.765246	36.18	.234754	40
21	8.766675	35.88	9.999257	.12	8.767417	36.02	11.232583	39
22	.768828	35.70	.999250	.13	.769578	35.82	.230422	38
23	.770970	35.52	.999242	.12	.771727	35.65	.228273	37
24	.773101	35.37	.999235	.13	.773866	35.48	.226134	36
25	.775223	35.17	.999227	.12	.775995	35.32	.224005	35
26	.777333	35.02	.999220	.13	.778114	35.13	.221886	34
27	.779434	34.83	.999212	.12	.780222	34.97	.219778	33
28	.781524	34.68	.999205	.13	.782320	34.80	.217680	32
29	.783605	34.50	.999197	.13	.784408	34.63	.215592	31
30	.785675	34.35	.999189	.13	.786486	34.47	.213514	30
31	8.787736	34.18	9.999181	.12	8.788554	34.32	11.211446	29
32	.789787	34.02	.999174	.13	.790613	34.15	.209387	28
33	.791828	33.85	.999166	.13	.792662	33.98	.207338	27
34	.793859	33.70	.999158	.13	.794701	33.83	.205299	26
35	.795881	33.55	.999150	.13	.796731	33.68	.203269	25
36	.797894	33.38	.999142	.13	.798752	33.52	.201248	24
37	.799897	33.25	.999134	.13	.800763	33.37	.199237	23
38	.801892	33.07	.999126	.13	.802765	33.22	.197235	22
39	.803876	32.93	.999118	.13	.804758	33.07	.195242	21
40	.805852	32.78	.999110	.13	.806742	32.92	.193258	20
41	8.807819	32.63	9.999102	.13	8.808717	32.77	11.191283	19
42	.809777	32.48	.999094	.13	.810683	32.63	.189317	18
43	.811726	32.35	.999086	.15	.812641	32.47	.187359	17
44	.813667	32.20	.999077	.13	.814589	32.33	.185411	16
45	.815599	32.05	.999069	.13	.816529	32.20	.183471	15
46	.817522	31.90	.999061	.13	.818461	32.05	.181539	14
47	.819436	31.78	.999053	.15	.820384	31.90	.179616	13
48	.821343	31.62	.999044	.13	.822298	31.78	.177702	12
49	.823240	31.50	.999036	.15	.824205	31.63	.175795	11
50	.825130	31.35	.999027	.13	.826103	31.48	.173897	10
51	8.827011	31.22	9.999019	.15	8.827992	31.37	11.172008	9
52	.828884	31.08	.999010	.13	.829874	31.23	.170126	8
53	.830749	30.97	.999002	.15	.831748	31.08	.168252	7
54	.832607	30.82	.998993	.15	.833613	30.97	.166387	6
55	.834456	30.68	.998984	.13	.835471	30.83	.164529	5
56	.836297	30.55	.998976	.15	.837321	30.70	.162679	4
57	.838130	30.43	.998967	.15	.839163	30.58	.160837	3
58	.839956	30.30	.998958	.13	.840998	30.45	.159002	2
59	.841774	30.18	.998950	.15	.842825	30.32	.157175	1
60	8.843585		9.998941		8.844644		11.155356	0
′	Cosine.	D 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	8.843585	30.03	9.998941	.15	8.844644	30.18	11.155356	60
1	.845387	29.93	.998932	.15	.846455	30.08	.153545	59
2	.847183	29.80	.998923	.15	.848260	29.95	.151740	58
3	.848971	29.67	.998914	.15	.850057	29.82	.149943	57
4	.850751	29.57	.998905	.15	.851846	29.70	.148154	56
5	.852525	29.43	.998896	.15	.853628	29.58	.146372	55
6	.854291	29.30	.998887	.15	.855403	29.47	.144597	54
7	.856049	29.20	.998878	.15	.857171	29.35	.142829	53
8	.857801	29.08	.998869	.15	.858932	29.23	.141068	52
9	.859546	28.95	.998860	.15	.860686	29.12	.139314	51
10	.861283	28.85	.998851	.17	.862433	29.00	.137567	50
11	8.863014	28.73	9.998841	.15	8.864173	28.88	11.135827	49
12	.864738	28.62	.998832	.15	.865906	28.77	.134094	48
13	.866455	28.50	.998823	.17	.867632	28.65	.132368	47
14	.868165	28.38	.998813	.15	.869351	28.55	.130649	46
15	.869868	28.28	.998804	.15	.871064	28.43	.128936	45
16	.871565	28.17	.998795	.17	.872770	28.32	.127230	44
17	.873255	28.05	.998785	.15	.874469	28.22	.125531	43
18	.874938	27.95	.998776	.17	.876162	28.12	.123838	42
19	.876615	27.83	.998766	.15	.877849	28.00	.122151	41
20	.878285	27.73	.998757	.17	.879529	27.88	.120471	40
21	8.879949	27.63	9.998747	.15	8.881202	27.78	11.118798	39
22	.881607	27.52	.998738	.17	.882869	27.68	.117131	38
23	.883258	27.42	.998728	.17	.884530	27.58	.115470	37
24	.884903	27.32	.998718	.17	.886185	27.47	.113815	36
25	.886542	27.20	.998708	.15	.887833	27.38	.112167	35
26	.888174	27.12	.998699	.17	.889476	27.27	.110524	34
27	.889801	27.00	.998689	.17	.891112	27.17	.108888	33
28	.891421	26.90	.998679	.17	.892742	27.07	.107258	32
29	.893035	26.80	.998669	.17	.894366	26.97	.105634	31
30	.894643	26.72	.998659	.17	.895984	26.87	.104016	30
31	8.896246	26.60	9.998649	.17	8.897596	26.78	11.102404	29
32	.897842	26.50	.998639	.17	.899203	26.67	.100797	28
33	.899432	26.42	.998629	.17	.900803	26.58	.099197	27
34	.901017	26.32	.998619	.17	.902398	26.48	.097602	26
35	.902596	26.22	.998609	.17	.903987	26.38	.096013	25
36	.904169	26.12	.998599	.17	.905570	26.28	.094430	24
37	.905736	26.02	.998589	.18	.907147	26.20	.092853	23
38	.907297	25.93	.998578	.17	.908719	26.10	.091281	22
39	.908853	25.85	.998568	.17	.910285	26.02	.089715	21
40	.910404	25.75	.998558	.17	.911846	25.92	.088154	20
41	8.911949	25.65	9.998548	.18	8.913401	25.83	11.086599	19
42	.913488	25.57	.998537	.17	.914951	25.73	.085049	18
43	.915022	25.47	.998527	.18	.916495	25.63	.083505	17
44	.916550	25.38	.998516	.17	.918034	25.57	.081966	16
45	.918073	25.30	.998506	.18	.919568	25.47	.080432	15
46	.919591	25.20	.998495	.17	.921096	25.38	.078904	14
47	.921103	25.12	.998485	.18	.922619	25.28	.077381	13
48	.922610	25.03	.998474	.17	.924136	25.22	.075864	12
49	.924112	24.95	.998464	.18	.925649	25.12	.074351	11
50	.925609	24.85	.998453	.18	.927156	25.03	.072844	10
51	8.927100	24.78	9.998442	.18	8.928658	24.95	11.071342	9
52	.928587	24.68	.998431	.17	.930155	24.87	.069845	8
53	.930068	24.60	.998421	.18	.931647	24.78	.068353	7
54	.931544	24.52	.998410	.18	.933134	24.70	.066866	6
55	.933015	24.43	.998399	.18	.934616	24.62	.065384	5
56	.934481	24.35	.998388	.18	.936093	24.53	.063907	4
57	.935942	24.27	.998377	.18	.937565	24.45	.062435	3
58	.937398	24.20	.998366	.18	.939032	24.37	.060968	2
59	.938850	24.10	.998355	.18	.940494	24.30	.059506	1
60	8.940296		9.998344		8.941952		11.058048	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	8.940296	24.03	9.998344	.18	8.941952	24.20	11.058048	60
1	.941738	23.93	.998333	.18	.943404	24.13	.056596	59
2	.943174	23.87	.998322	.18	.944852	24.05	.055148	58
3	.944606	23.80	.998311	.18	.946295	23.98	.053705	57
4	.946034	23.70	.998300	.18	.947734	23.90	.052266	56
5	.947456	23.63	.998289	.20	.949168	23.82	.050832	55
6	.948874	23.55	.998277	.18	.950597	23.73	.049403	54
7	.950287	23.48	.998266	.18	.952021	23.67	.047979	53
8	.951696	23.40	.998255	.20	.953441	23.58	.046559	52
9	.953100	23.32	.998243	.18	.954856	23.52	.045144	51
10	.954499	23.25	.998232	.20	.956267	23.45	.043733	50
11	8.955894	23.17	9.998220	.18	8.957674	23.35	11.042326	49
12	.957284	23.10	.998209	.20	.959075	23.30	.040925	48
13	.958670	23.03	.998197	.18	.960473	23.22	.039527	47
14	.960052	22.95	.998186	.20	.961866	23.15	.038134	46
15	.961429	22.87	.998174	.18	.963255	23.07	.036745	45
16	.962801	22.82	.998163	.20	.964639	23.00	.035361	44
17	.964170	22.73	.998151	.20	.966019	22.92	.033981	43
18	.965534	22.65	.998139	.18	.967394	22.87	.032606	42
19	.966893	22.60	.998128	.20	.968766	22.78	.031234	41
20	.968249	22.52	.998116	.20	.970133	22.72	.029867	40
21	8.969600	22.45	9.998104	.20	8.971496	22.65	11.028504	39
22	.970947	22.37	.998092	.20	.972855	22.57	.027145	38
23	.972289	22.32	.998080	.20	.974209	22.52	.025791	37
24	.973628	22.23	.998068	.20	.975560	22.43	.024440	36
25	.974962	22.18	.998056	.20	.976906	22.37	.023094	35
26	.976293	22.10	.998044	.20	.978248	22.30	.021752	34
27	.977619	22.03	.998032	.20	.979586	22.25	.020414	33
28	.978941	21.97	.998020	.20	.980921	22.17	.019079	32
29	.980259	21.90	.998008	.20	.982251	22.10	.017749	31
30	.981573	21.83	.997996	.20	.983577	22.03	.016423	30
31	8.982883	21.77	9.997984	.20	8.984899	21.97	11.015101	29
32	.984189	21.72	.997972	.22	.986217	21.92	.013783	28
33	.985491	21.63	.997959	.20	.987532	21.83	.012468	27
34	.986789	21.57	.997947	.20	.988842	21.78	.011158	26
35	.988083	21.52	.997935	.22	.990149	21.70	.009851	25
36	.989374	21.43	.997922	.20	.991451	21.65	.008549	24
37	.990660	21.38	.997910	.22	.992750	21.58	.007250	23
38	.991943	21.32	.997897	.20	.994045	21.53	.005955	22
39	.993222	21.25	.997885	.22	.995337	21.45	.004663	21
40	.994497	21.18	.997872	.20	.996624	21.40	.003376	20
41	8.995768	21.13	9.997860	.22	8.997908	21.33	11.002092	19
42	.997036	21.05	.997847	.20	8.999188	21.28	11.000812	18
43	.998299	21.02	.997835	.22	9.000465	21.22	10.999535	17
44	8.999560	20.93	.997822	.22	.001738	21.15	.998262	16
45	9.000816	20.88	.997809	.20	.003007	21.08	.996993	15
46	.002069	20.82	.997797	.22	.004272	21.03	.995728	14
47	.003318	20.75	.997784	.22	.005534	20.97	.994466	13
48	.004563	20.70	.997771	.22	.006792	20.92	.993208	12
49	.005805	20.65	.997758	.22	.008047	20.85	.991953	11
50	.007044	20.57	.997745	.22	.009298	20.80	.990702	10
51	9.008278	20.53	9.997732	.22	9.010546	20.73	10.989454	9
52	.009510	20.45	.997719	.22	.011790	20.68	.988210	8
53	.010737	20.42	.997706	.22	.013031	20.62	.986969	7
54	.011962	20.33	.997693	.22	.014268	20.57	.985732	6
55	.013182	20.30	.997680	.22	.015502	20.50	.984498	5
56	.014400	20.22	.997667	.22	.016732	20.45	.983268	4
57	.015613	20.18	.997654	.22	.017959	20.40	.982041	3
58	.016824	20.12	.997641	.22	.019183	20.33	.980817	2
59	.018031	20.07	.997628	.23	.020403	20.28	.979597	1
60	9.019235		9.997614		9.021620		10.978380	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.019235	20.00	9.997614	.22	9.021620	20.23	10.978380	60
1	.020435	19.95	.997601	.22	.022834	20.17	.977166	59
2	.021632	19.88	.997588	.23	.024044	20.12	.975956	58
3	.022825	19.85	.997574	.22	.025251	20.07	.974749	57
4	.024016	19.78	.997561	.23	.026455	20.00	.973545	56
5	.025203	19.72	.997547	.22	.027655	19.95	.972345	55
6	.026386	19.68	.997534	.23	.028852	19.90	.971148	54
7	.027567	19.62	.997520	.22	.030046	19.85	.969954	53
8	.028744	19.57	.997507	.23	.031237	19.80	.968763	52
9	.029918	19 52	.997493	.22	.032425	19.73	.967575	51
10	.031089	19.47	.997480	.23	.033609	19.70	.966391	50
11	9.032257	19.40	9.997466	.23	9.034791	19.63	10.965209	49
12	.033421	19.35	.997452	.22	.035969	19.58	.964031	48
13	.034582	19.32	.997439	.23	.037144	19.53	.962856	47
14	.035741	19.25	.997425	.23	.038316	19.48	.961684	46
15	.036896	19.20	.997411	.23	.039485	19.43	.960515	45
16	.038048	19.15	.997397	.23	.040651	19.37	.959349	44
17	.039197	19.08	.997383	.23	.041813	19.33	.958187	43
18	.040342	19.05	.997369	.23	.042973	19.28	.957027	42
19	.041485	19.00	.997355	.23	.044130	19.23	.955870	41
20	.042625	18.95	.997341	.23	.045284	19.17	.954716	40
21	9.043762	18.88	9.997327	.23	9.046434	19.13	10.953566	39
22	.044895	18.85	.997313	.23	.047582	19.08	.952418	38
23	.046026	18.80	.997299	.23	.048727	19.03	.951273	37
24	.047154	18.75	.997285	.23	.049869	18.98	.950131	36
25	.048279	18.68	.997271	.23	.051008	18.93	.948992	35
26	.049400	18.65	.997257	.25	.052144	18.88	.947856	34
27	.050519	18.60	.997242	.23	.053277	18 83	.946723	33
28	.051635	18.57	.997228	.23	.054407	18.80	.945593	32
29	.052749	18.50	.997214	.25	.055535	18.73	.944465	31
30	.053859	18.45	.997199	.23	.056659	18.70	.943341	30
31	9.054966	18.42	9.997185	.25	9.057781	18.65	10.942219	29
32	.056071	18.35	.997170	.23	.058900	18.60	.941100	28
33	.057172	18.32	.997156	.25	.060016	18.57	.939984	27
34	.058271	18.27	.997141	.23	.061130	18.50	.938870	26
35	.059367	18.22	.997127	.25	.062240	18.47	.937760	25
36	.060460	18.18	.997112	.23	.063348	18.42	.936652	24
37	.061551	18.13	.997098	.25	.064453	18.38	.935547	23
38	.062639	18.08	.997083	.25	.065556	18.32	.934444	22
39	.063724	18.03	.997068	.25	.066655	18.28	.933345	21
40	.064806	17.98	.997053	.23	.067752	18.25	.932248	20
41	9.065885	17.95	9.997039	.25	9.068846	18.20	10.931154	19
42	.066962	17.90	.997024	.25	.069938	18.15	.930062	18
43	.068036	17.85	.997009	.25	.071027	18.10	.928973	17
44	.069107	17.82	.996994	.25	.072113	18.07	.927887	16
45	.070176	17.77	.996979	.25	.073197	18.02	.926803	15
46	.071242	17.73	.996964	.25	.074278	17.97	.925722	14
47	.072306	17.67	.996949	.25	.075356	17.93	.924644	13
48	.073366	17.63	.996934	.25	.076432	17.88	.923568	12
49	.074424	17.60	.996919	.25	.077505	17.85	.922495	11
50	.075480	17.55	.996904	.25	.078576	17.80	.921424	10
51	9.076533	17.50	9.996889	.25	9.079644	17.77	10.920356	9
52	.077583	17.47	.996874	.27	.080710	17.72	.919290	8
53	.078631	17.42	.996858	.25	.081773	17.67	.918227	7
54	.079676	17.38	.996843	.27	.082833	17.63	.917167	6
55	.080719	17.33	.996828	.27	.083891	17.60	.916109	5
56	.081759	17.30	.996812	.25	.084947	17.55	.915053	4
57	.082797	17.25	.996797	.25	.086000	17.50	.914000	3
58	.083832	17.20	.996782	.27	.087050	17.47	.912950	2
59	.084864	17.17	.996766	.25	.088098	17.43	.911902	1
60	9.085894		9.996751		9.089144		10.910856	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.085894	17.13	9.996751	.27	9.089144	17.38	10.910856	60
1	.086922	17.08	.996735	.25	.090187	17.35	.909813	59
2	.087947	17.05	.996720	.27	.091228	17.30	.908772	58
3	.088970	17.00	.996704	.27	.092266	17.27	.907734	57
4	.089990	16.97	.996688	.25	.093302	17.23	.906698	56
5	.091008	16.93	.996673	.27	.094336	17.18	.905664	55
6	.092024	16.88	.996657	.27	.095367	17.13	.904633	54
7	.093037	16.83	.996641	.27	.096395	17.12	.903605	53
8	.094047	16.82	.996625	.25	.097422	17.07	.902578	52
9	.095056	16.77	.996610	.27	.098446	17.03	.901554	51
10	.096062	16.72	.996594	.27	.099468	16.98	.900532	50
11	9.097065	16.68	9.996578	.27	9.100487	16.95	10.899513	49
12	.098066	16.65	.996562	.27	.101504	16.92	.898496	48
13	.099065	16.62	.996546	.27	.102519	16.88	.897481	47
14	.100062	16.57	.996530	.27	.103532	16.83	.896468	46
15	.101056	16.53	.996514	.27	.104542	16.80	.895458	45
16	.102048	16.48	.996498	.27	.105550	16.77	.894450	44
17	.103037	16.47	.996482	.28	.106556	16.72	.893444	43
18	.104025	16.42	.996465	.27	.107559	16.68	.892441	42
19	.105010	16.37	.996449	.27	.108560	16.65	.891440	41
20	.105992	16.35	.996433	.27	.109559	16.62	.890441	40
21	9.106973	16.30	9.996417	.28	9.110556	16.58	10.889444	39
22	.107951	16.27	.996400	.27	.111551	16.53	.888449	38
23	.108927	16.23	.996384	.27	.112543	16.50	.887457	37
24	.109901	16.20	.996368	.28	.113533	16.47	.886467	36
25	.110873	16.15	.996351	.27	.114521	16.43	.885479	35
26	.111842	16.12	.996335	.28	.115507	16.40	.884493	34
27	.112809	16.08	.996318	.27	.116491	16.35	.883509	33
28	.113774	16.05	.996302	.28	.117472	16.33	.882528	32
29	.114737	16.02	.996285	.27	.118452	16.28	.881548	31
30	.115698	15.97	.996269	.28	.119429	16.25	.880571	30
31	9.116656	15.95	9.996252	.28	9.120404	16.22	10.879596	29
32	.117613	15.90	.996235	.27	.121377	16.18	.878623	28
33	.118567	15.87	.996219	.28	.122348	16.15	.877652	27
34	.119519	15.83	.996202	.28	.123317	16.12	.876683	26
35	.120469	15.80	.996185	.28	.124284	16.08	.875716	25
36	.121417	15.75	.996168	.28	.125249	16.03	.874751	24
37	.122362	15.73	.996151	.28	.126211	16.02	.873789	23
38	.123306	15.70	.996134	.28	.127172	15.97	.872828	22
39	.124248	15.65	.996117	.28	.128130	15.95	.871870	21
40	.125187	15.63	.996100	.28	.129087	15.90	.870913	20
41	9.126125	15.58	9.996083	.28	9.130041	15.88	10.869959	19
42	.127060	15.55	.996066	.28	.130994	15.83	.869006	18
43	.127993	15.53	.996049	.28	.131944	15.82	.868056	17
44	.128925	15.48	.996032	.28	.132893	15.77	.867107	16
45	.129854	15.45	.996015	.28	.133839	15.75	.866161	15
46	.130781	15.42	.995998	.30	.134784	15.70	.865216	14
47	.131706	15.40	.995980	.28	.135726	15.68	.864274	13
48	.132630	15.35	.995963	.28	.136667	15.63	.863333	12
49	.133551	15.32	.995946	.30	.137605	15.62	.862395	11
50	.134470	15.28	.995928	.28	.138542	15.57	.861458	10
51	9.135387	15.27	9.995911	.28	9.139476	15.55	10.860524	9
52	.136303	15.22	.995894	.30	.140409	15.52	.859591	8
53	.137216	15.20	.995876	.28	.141340	15.48	.858660	7
54	.138128	15.15	.995859	.30	.142269	15.45	.857731	6
55	.139037	15.12	.995841	.30	.143196	15.42	.856804	5
56	.139944	15.10	.995823	.28	.144121	15.38	.855879	4
57	.140850	15.07	.995806	.30	.145044	15.37	.854956	3
58	.141754	15.02	.995788	.28	.145966	15.32	.854034	2
59	.142655	15.00	.995771	.30	.146885	15.30	.853115	1
60	9.143555		9.995753		9.147803		10.852197	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.143555	14.97	9.995753	.30	9.147803	15.25	10.852197	60
1	.144453	14.93	.995735	.30	.148718	15.23	.851282	59
2	.145349	14.90	.995717	.30	.149632	15.20	.850368	58
3	.146243	14.88	.995699	.30	.150544	15.17	.849456	57
4	.147136	14.83	.995681	.28	.151454	15.15	.848546	56
5	.148026	14.82	.995664	.30	.152363	15.10	.847637	55
6	.148915	14.78	.995646	.30	.153269	15.08	.846731	54
7	.149802	14.73	.995628	.30	.154174	15.05	.845826	53
8	.150686	14.72	.995610	.32	.155077	15.02	.844923	52
9	.151569	14.70	.995591	.30	.155978	14.98	.844022	51
10	.152451	14.65	.995573	.30	.156877	14.97	.843123	50
11	9.153330	14.63	9.995555	.30	9.157775	14.93	10.842225	49
12	.154208	14.58	.995537	.30	.158671	14.90	.841329	48
13	.155083	14.57	.995519	.30	.159565	14.87	.840435	47
14	.155957	14.55	.995501	.32	.160457	14.83	.839543	46
15	.156830	14.50	.995482	.30	.161347	14.82	.838653	45
16	.157700	14.48	.995464	.30	.162236	14.78	.837764	44
17	.158569	14.43	.995446	.32	.163123	14.75	.836877	43
18	.159435	14.43	.995427	.30	.164008	14.73	.835992	42
19	.160301	14.38	.995409	.32	.164892	14.70	.835108	41
20	.161164	14.35	.995390	.30	.165774	14.67	.834226	40
21	9.162025	14.33	9.995372	.32	9.166654	14.63	10.833346	39
22	.162885	14.30	.995353	.32	.167532	14.62	.832468	38
23	.163743	14.28	.995334	.30	.168409	14.58	.831591	37
24	.164600	14.23	.995316	.32	.169284	14.55	.830716	36
25	.165454	14.22	.995297	.32	.170157	14.53	.829843	35
26	.166307	14.20	.995278	.30	.171029	14.50	.828971	34
27	.167159	14.15	.995260	.32	.171899	14.47	.828101	33
28	.168008	14.13	.995241	.32	.172767	14.45	.827233	32
29	.168856	14.10	.995222	.32	.173634	14.42	.826366	31
30	.169702	14.08	.995203	.32	.174499	14.38	.825501	30
31	9.170547	14.03	9.995184	.32	9.175362	14.37	10.824638	29
32	.171389	14.02	.995165	.32	.176224	14.33	.823776	28
33	.172230	14.00	.995146	.32	.177084	14.30	.822916	27
34	.173070	13.97	.995127	.32	.177942	14.28	.822058	26
35	.173908	13.93	.995108	.32	.178799	14 27	.821201	25
36	.174744	13.90	.995089	.32	.179655	14.22	.820345	24
37	.175578	13.88	.995070	.32	.180508	14.20	.819492	23
38	.176411	13 85	.995051	.32	.181360	14.18	.818640	22
39	.177242	13.83	.995032	.32	.182211	14.13	.817789	21
40	.178072	13.80	.995013	.33	.183059	14.13	.816941	20
41	9 178900	13.77	9.994993	.32	9.183907	14.08	10.816093	19
42	.179726	13.75	.994974	.32	.184752	14.08	.815248	18
43	.180551	13.72	.994955	.33	.185597	14.03	.814403	17
44	.181374	13.70	.994935	.32	.186439	14.02	.813561	16
45	.182196	13.67	.994916	.33	.187280	14.00	.812720	15
46	.183016	13.63	.994896	.32	.188120	13.97	.811880	14
47	.183834	13.62	.994877	.33	.188958	13.93	.811042	13
48	.184651	13.58	.994857	.32	.189794	13.92	.810206	12
49	.185466	13.57	.994838	.33	.190629	13.88	.809371	11
50	.186280	13.53	.994818	.33	.191462	13.87	.808538	10
51	9.187092	13.52	9.994798	.32	9.192294	13.83	10.807706	9
52	.187903	13.48	.994779	.33	.193124	13.82	.806876	8
53	.188712	13.45	.994759	.33	.193953	13.78	.806047	7
54	.189519	13.43	.994739	.32	.194780	13.77	.805220	6
55	.190325	13.42	.994720	.33	.195606	13.73	.804394	5
56	.191130	13.38	.994700	.33	.196430	13.72	.803570	4
57	.191933	13.35	.994680	.33	.197253	13.68	.802747	3
58	.192734	13 33	.994660	.33	.198074	13.67	.801926	2
59	.193534	13.30	.994640	.33	.198894	13.65	.801106	1
60	9.194332		9.994620		9.199713		10.800287	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.194332	13.28	9.994620	.33	9.199713	13.60	10.800287	60
1	.195129	13.27	.994600	.33	.200529	13.60	.799471	59
2	.195925	13.23	.994580	.33	.201345	13.57	.798655	58
3	.196719	13.20	.994560	.33	.202159	13.53	.797841	57
4	.197511	13.18	.994540	.35	.202971	13.52	.797029	56
5	.198302	13.15	.994519	.33	.203782	13.50	.796218	55
6	.199091	13.13	.994499	.33	.204592	13.47	.795408	54
7	.199879	13.12	.994479	.33	.205400	13.45	.794600	53
8	.200666	13.08	.994459	.35	.206207	13.43	.793793	52
9	.201451	13.05	.994438	.33	.207013	13.40	.792987	51
10	.202234	13.05	.994418	.33	.207817	13.37	.792183	50
11	9.203017	13.00	9.994398	.35	9.208619	13.35	10.791381	49
12	.203797	13.00	.994377	.33	.209420	13.33	.790580	48
13	.204577	12.95	.994357	.35	.210220	13.30	.789780	47
14	.205354	12.95	.994336	.33	.211018	13.28	.788982	46
15	.206131	12.92	.994316	.35	.211815	13.27	.788185	45
16	.206906	12.88	.994295	.35	.212611	13.23	.787389	44
17	.207679	12.88	.994274	.33	.213405	13.22	.786595	43
18	.208452	12.83	.994254	.35	.214198	13.18	.785802	42
19	.209222	12.83	.994233	.35	.214989	13.18	.785011	41
20	.209992	12.80	.994212	.35	.215780	13.13	.784220	40
21	9.210760	12.77	9.994191	.33	9.216568	13.13	10.783432	39
22	.211526	12.75	.994171	.35	.217356	13.10	.782644	38
23	.212291	12.73	.994150	.35	.218142	13.07	.781858	37
24	.213055	12.72	.994129	.35	.218926	13.07	.781074	36
25	.213818	12.68	.994108	.35	.219710	13.03	.780290	35
26	.214579	12.65	.994087	.35	.220492	13.00	.779508	34
27	.215338	12.65	.994066	.35	.221272	13.00	.778728	33
28	.216097	12.62	.994045	.35	.222052	12.97	.777948	32
29	.216854	12.58	.994024	.35	.222830	12.95	.777170	31
30	.217609	12.57	.994003	.35	.223607	12.92	.776393	30
31	9.218363	12.55	9.993982	.37	9.224382	12.90	10.775618	29
32	.219116	12.53	.993960	.35	.225156	12.88	.774844	28
33	.219868	12.50	.993939	.35	.225929	12.85	.774071	27
34	.220618	12.48	.993918	.35	.226700	12.85	.773300	26
35	.221367	12.47	.993897	.37	.227471	12.80	.772529	25
36	.222115	12.43	.993875	.35	.228239	12.80	.771761	24
37	.222861	12.42	.993854	.37	.229007	12.77	.770993	23
38	.223606	12.38	.993832	.35	.229773	12.77	.770227	22
39	.224349	12.38	.993811	.37	.230539	12.72	.769461	21
40	.225092	12.35	.993789	.35	.231302	12.72	.768698	20
41	9.225833	12.33	9.993768	.37	9.232065	12.68	10.767935	19
42	.226573	12.30	.993746	.35	.232826	12.67	.767174	18
43	.227311	12.28	.993725	.37	.233586	12.65	.766414	17
44	.228048	12.27	.993703	.37	.234345	12.63	.765655	16
45	.228784	12.23	.993681	.35	.235103	12.60	.764897	15
46	.229518	12.23	.993660	.37	.235859	12.58	.764141	14
47	.230252	12.20	.993638	.37	.236614	12.57	.763386	13
48	.230984	12.18	.993616	.37	.237368	12.53	.762632	12
49	.231715	12.15	.993594	.37	.238120	12.53	.761880	11
50	.232444	12.13	.993572	.37	.238872	12.50	.761128	10
51	9.233172	12.12	9.993550	.37	9.239622	12.48	10.760378	9
52	.233899	12.10	.993528	.37	.240371	12.45	.759629	8
53	.234625	12.07	.993506	.37	.241118	12.45	.758882	7
54	.235349	12.07	.993484	.37	.241865	12.42	.758135	6
55	.236073	12.03	.993462	.37	.242610	12.40	.757390	5
56	.236795	12.00	.993440	.37	.243354	12.38	.756646	4
57	.237515	12.00	.993418	.37	.244097	12.37	.755903	3
58	.238235	11.97	.993396	.37	.244839	12.33	.755161	2
59	.238953	11.95	.993374	.38	.245579	12.33	.754421	1
60	9.239670		9.993351		9.246319		10.753681	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.239670	11.93	9.993351	.37	9.246319	12.30	10.753681	60
1	.240386	11.92	.993329	.37	.247057	12.28	.752943	59
2	.241101	11.88	.993307	.38	.247794	12.27	.752206	58
3	.241814	11.87	.993284	.37	.248530	12.23	.751470	57
4	.242526	11.85	.993262	.37	.249264	12.23	.750736	56
5	.243237	11.83	.993240	.38	.249998	12.20	.750002	55
6	.243947	11.82	.993217	.37	.250730	12.18	.749270	54
7	.244656	11.78	.993195	.38	.251461	12.17	.748539	53
8	.245363	11.77	.993172	.38	.252191	12.15	.747809	52
9	.246069	11.77	.993149	.37	.252920	12.13	.747080	51
10	.246775	11.72	.993127	.38	.253648	12.10	.746352	50
11	9.247478	11.72	9.993104	.38	9.254374	12.10	10.745626	49
12	.248181	11.70	.993081	.37	.255100	12.07	.744900	48
13	.248883	11.67	.993059	.38	.255824	12.05	.744176	47
14	.249583	11.65	.993036	.38	.256547	12.03	.743453	46
15	.250282	11.63	.993013	.38	.257269	12.02	.742731	45
16	.250980	11.62	.992990	.38	.257990	12.00	.742010	44
17	.251677	11.60	.992967	.38	.258710	11.98	.741290	43
18	.252373	11.57	.992944	.38	.259429	11.95	.740571	42
19	.253067	11.57	.992921	.38	.260146	11.95	.739854	41
20	.253761	11.53	.992898	.38	.260863	11.92	.739137	40
21	9.254453	11.52	9.992875	.38	9.261578	11.90	10.738422	39
22	.255144	11.50	.992852	.38	.262292	11.88	.737708	38
23	.255834	11.48	.992829	.38	.263005	11.87	.736995	37
24	.256523	11.47	.992806	.38	.263717	11.85	.736283	36
25	.257211	11.45	.992783	.40	.264428	11.83	.735572	35
26	.257898	11.42	.992759	.38	.265138	11.82	.734862	34
27	.258583	11.42	.992736	.38	.265847	11.80	.734153	33
28	.259268	11.38	.992713	.38	.266555	11.77	.733445	32
29	.259951	11.37	.992690	.40	.267261	11.77	.732739	31
30	.260633	11.35	.992666	.38	.267967	11.73	.732033	30
31	9.261314	11.33	9.992643	.40	9.268671	11.73	10.731329	29
32	.261994	11.32	.992619	.38	.269375	11.70	.730625	28
33	.262673	11.30	.992596	.40	.270077	11.70	.729923	27
34	.263351	11.27	.992572	.38	.270779	11.67	.729221	26
35	.264027	11.27	.992549	.40	.271479	11.65	.728521	25
36	.264703	11.23	.992525	.40	.272178	11.63	.727822	24
37	.265377	11.23	.992501	.38	.272876	11.62	.727124	23
38	.266051	11.20	.992478	.40	.273573	11.60	.726427	22
39	.266723	11.20	.992454	.40	.274269	11.58	.725731	21
40	.267395	11.17	.992430	.40	.274964	11.57	.725036	20
41	9.268065	11.15	9.992406	.40	9.275658	11.55	10.724342	19
42	.268734	11.13	.992382	.38	.276351	11.53	.723649	18
43	.269402	11.12	.992359	.40	.277043	11.52	.722957	17
44	.270069	11.10	.992335	.40	.277734	11.50	.722266	16
45	.270735	11.08	.992311	.40	.278424	11.48	.721576	15
46	.271400	11.07	.992287	.40	.279113	11.47	.720887	14
47	.272064	11.03	.992263	.40	.279801	11.45	.720199	13
48	.272726	11.03	.992239	.42	.280488	11.43	.719512	12
49	.273388	11.02	.992214	.40	.281174	11.40	.718826	11
50	.274049	10.98	.992190	.40	.281858	11.40	.718142	10
51	9.274708	10.98	9.992166	.40	9.282542	11.38	10.717458	9
52	.275367	10.97	.992142	.40	.283225	11.37	.716775	8
53	.276025	10.93	.992118	.42	.283907	11.35	.716093	7
54	.276681	10.93	.992093	.40	.284588	11.33	.715412	6
55	.277337	10.90	.992069	.42	.285268	11.32	.714732	5
56	.277991	10.90	.992044	.40	.285947	11.28	.714053	4
57	.278645	10.87	.992020	.40	.286624	11.28	.713376	3
58	.279297	10.85	.991996	.42	.287301	11.27	.712699	2
59	.279948	10.85	.991971	.40	.287977	11.25	.712023	1
60	9.280599		9.991947		9.288652		10.711348	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.280599	10.82	9.991947	.42	9.288652	11.23	10.711348	60
1	.281248	10.82	.991922	.42	.289326	11.22	.710674	59
2	.281897	10.78	.991897	.40	.289999	11.20	.710001	58
3	.282544	10.77	.991873	.42	.290671	11.18	.709329	57
4	.283190	10.77	.991848	.42	.291342	11.18	.708658	56
5	.283836	10.73	.991823	.40	.292013	11.15	.707987	55
6	.284480	10.73	.991799	.42	.292682	11.13	.707318	54
7	.285124	10.70	.991774	.42	.293350	11.12	.706650	53
8	.285766	10.70	.991749	.42	.294017	11.12	.705983	52
9	.286408	10.67	.991724	.42	.294684	11.08	.705316	51
10	.287048	10.67	.991699	.42	.295349	11.07	.704651	50
11	9.287688	10.63	9.991674	.42	9.296013	11.07	10.703987	49
12	.288326	10.63	.991649	.42	.296677	11.03	.703323	48
13	.288964	10.60	.991624	.42	.297339	11.03	.702661	47
14	.289600	10.60	.991599	.42	.298001	11.02	.701999	46
15	.290236	10.57	.991574	.42	.298662	11.00	.701338	45
16	.290870	10.57	.991549	.42	.299322	10.97	.700678	44
17	.291504	10.55	.991524	.43	.299980	10.97	.700020	43
18	.292137	10.52	.991498	.42	.300638	10.95	.699362	42
19	.292768	10.52	.991473	.42	.301295	10.93	.698705	41
20	.293399	10.50	.991448	.43	.301951	10.93	.698049	40
21	9.294029	10.48	9.991422	.42	9.302607	10.90	10.697393	39
22	.294658	10.47	.991397	.42	.303261	10.88	.696739	38
23	.295286	10.45	.991372	.43	.303914	10.88	.696086	37
24	.295913	10.43	.991346	.42	.304567	10.85	.695433	36
25	.296539	10.42	.991321	.43	.305218	10.85	.694782	35
26	.297164	10.40	.991295	.42	.305869	10.83	.694131	34
27	.297788	10.40	.991270	.43	.306519	10.82	.693481	33
28	.298412	10.37	.991244	.43	.307168	10.80	.692832	32
29	.299034	10.35	.991218	.42	.307816	10.78	.692184	31
30	.299655	10.35	.991193	.43	.308463	10.77	.691537	30
31	9.300276	10.32	9.991167	.43	9.309109	10.75	10.690891	29
32	.300895	10.32	.991141	.43	.309754	10.75	.690246	28
33	.301514	10.30	.991115	.42	.310399	10.72	.689601	27
34	.302132	10.27	.991090	.43	.311042	10.72	.688958	26
35	.302748	10.27	.991064	.43	.311685	10.70	.688315	25
36	.303364	10.25	.991038	.43	.312327	10.68	.687673	24
37	.303979	10.23	.991012	.43	.312968	10.67	.687032	23
38	.304593	10.23	.990986	.43	.313608	10.65	.686392	22
39	.305207	10.20	.990960	.43	.314247	10.63	.685753	21
40	.305819	10.18	.990934	.43	.314885	10.63	.685115	20
41	9.306430	10.18	9.990908	.43	9.315523	10.60	10.684477	19
42	.307041	10.15	.990882	.45	.316159	10.60	.683841	18
43	.307650	10.15	.990855	.43	.316795	10.58	.683205	17
44	.308259	10.13	.990829	.43	.317430	10.57	.682570	16
45	.308867	10.12	.990803	.43	.318064	10.55	.681936	15
46	.309474	10.10	.990777	.45	.318697	10.55	.681303	14
47	.310080	10.08	.990750	.43	319330	10.52	.680670	13
48	.310685	10.07	.990724	.45	.319961	10.52	.680039	12
49	.311289	10.07	.990697	.43	.320592	10.50	.679408	11
50	.311893	10.03	.990671	.43	.321222	10.48	.678778	10
51	9.312495	10.03	9.990645	.45	9.321851	10.47	10.678149	9
52	.313097	10.02	.990618	.45	.322479	10.45	.677521	8
53	.313698	9.98	.990591	.43	.323106	10.45	.676894	7
54	.314297	10.00	.990565	.45	.323733	10.42	.676267	6
55	.314897	9.97	.990538	.45	.324358	10.42	.675642	5
56	.315495	9.95	.990511	.43	.324983	10.40	.675017	4
57	.316092	9.95	.990485	.45	.325607	10.40	.674393	3
58	.316689	9.92	.990458	.45	.326231	10.37	.673769	2
59	.317284	9.92	.990431	.45	.326853	10.37	.673147	1
60	9.317879		9.990404		9.327475		10.672525	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.317879	9.90	9.990404	.43	9.327475	10.33	10.672525	60
1	.318473	9.88	.990378	.45	.328095	10.33	.671905	59
2	.319066	9.87	.990351	.45	.328715	10.32	.671285	58
3	.319658	9.85	.990324	.45	.329334	10.32	.670666	57
4	.320249	9.85	.990297	.45	.329953	10.28	.670047	56
5	.320840	9.83	.990270	.45	.330570	10.28	.669430	55
6	.321430	9.82	.990243	.47	.331187	10.27	.668813	54
7	.322019	9.80	.990215	.45	.331803	10.25	.668197	53
8	.322607	9.78	.990188	.45	.332418	10.25	.667582	52
9	.323194	9.77	.990161	.45	.333033	10.22	.666967	51
10	.323780	9.77	.990134	.45	.333646	10.22	.666354	50
11	9.324366	9.73	9.990107	.47	9.334259	10.20	10.665741	49
12	.324950	9.73	.990079	.45	.334871	10.18	.665129	48
13	.325534	9.72	.990052	.45	.335482	10.18	.664518	47
14	.326117	9.72	.990025	.47	.336093	10.15	.663907	46
15	.326700	9.68	.989997	.45	.336702	10.15	.663298	45
16	.327281	9.68	.989970	.47	.337311	10.13	.662689	44
17	.327862	9.67	.989942	.45	.337919	10.13	.662081	43
18	.328442	9.65	.989915	.47	.338527	10.10	.661473	42
19	.329021	9.63	.989887	.45	.339133	10.10	.660867	41
20	.329599	9.62	.989860	.47	.339739	10.08	.660261	40
21	9.330176	9.62	9.989832	.47	9.340344	10.07	10.659656	39
22	.330753	9.60	.989804	.45	.340948	10.07	.659052	38
23	.331329	9.57	.989777	.47	.341552	10.05	.658448	37
24	.331903	9.58	.989749	.47	.342155	10.03	.657845	36
25	.332478	9.55	.989721	.47	.342757	10.02	.657243	35
26	.333051	9.55	.989693	.47	.343358	10.00	.656642	34
27	.333624	9.52	.989665	.47	.343958	10.00	.656042	33
28	.334195	9.53	.989637	.45	.344558	9.98	.655442	32
29	.334767	9.50	.989610	.47	.345157	9.97	.654843	31
30	.335337	9.48	.989582	.48	.345755	9.97	.654245	30
31	9.335906	9.48	9.989553	.47	9.346353	9.93	10.653647	29
32	.336475	9.47	.989525	.47	.346949	9.93	.653051	28
33	.337043	9.45	.989497	.47	.347545	9.93	.652455	27
34	.337610	9.43	.989469	.47	.348141	9.90	.651859	26
35	.338176	9.43	.989441	.47	.348735	9.90	.651265	25
36	.338742	9.42	.989413	.47	.349329	9.88	.650671	24
37	.339307	9.40	.989385	.48	.349922	9.87	.650078	23
38	.339871	9.38	.989356	.47	.350514	9.87	.649486	22
39	.340434	9.37	.989328	.47	.351106	9.85	.648894	21
40	.340996	9.37	.989300	.48	.351697	9.83	.648303	20
41	9.341558	9.35	9.989271	.47	9.352287	9.82	10.647713	19
42	.342119	9.33	.989243	.48	.352876	9.82	.647124	18
43	.342679	9.33	.989214	.47	.353465	9.80	.646535	17
44	.343239	9.30	.989186	.48	.354053	9.78	.645947	16
45	.343797	9.30	.989157	.48	.354640	9.78	.645360	15
46	.344355	9.28	.989128	.47	.355227	9.77	.644773	14
47	.344912	9.28	.989100	.48	.355813	9.75	.644187	13
48	.345469	9.25	.989071	.48	.356398	9.73	.643602	12
49	.346024	9.25	.989042	.47	.356982	9.73	.643018	11
50	.346579	9.25	.989014	.48	.357566	9.72	.642434	10
51	9.347134	9.22	9.988985	.48	9.358149	9.70	10.641851	9
52	.347687	9.22	.988956	.48	.358731	9.70	.641269	8
53	.348240	9.20	.988927	.48	.359313	9.67	.640687	7
54	.348792	9.18	.988898	.48	.359893	9.68	.640107	6
55	.349343	9.17	.988869	.48	.360474	9.65	.639526	5
56	.349893	9.17	.988840	.48	.361053	9.65	.638947	4
57	.350443	9.15	.988811	.48	.361632	9.63	.638368	3
58	.350992	9.13	.988782	.48	.362210	9.62	.637790	2
59	.351540	9.13	.988753	.48	.362787	9.62	.637213	1
60	9.352088		9.988724		9.363364		10.636636	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.352088	9.12	9.988724	.48	9.363364	9.60	10.636636	60
1	.352635	9.10	.988695	.48	.363940	9.58	.636060	59
2	.353181	9.08	.988666	.50	.364515	9.58	.635485	58
3	.353726	9.08	.988636	.48	.365090	9.57	.634910	57
4	.354271	9.07	.988607	.48	.365664	9.55	.634336	56
5	.354815	9.05	.988578	.50	.366237	9.55	.633763	55
6	.355358	9.05	.988548	.48	.366810	9.53	.633190	54
7	.355901	9.03	.988519	.50	.367382	9.52	.632618	53
8	.356443	9.02	.988489	.48	.367953	9.52	.632047	52
9	.356984	9.00	.988460	.50	.368524	9.50	.631476	51
10	.357524	9.00	.988430	.48	.369094	9.48	.630906	50
11	9.358064	8.98	9.988401	.50	9.369663	9.48	10.630337	49
12	.358603	8.97	.988371	.48	.370232	9.45	.629768	48
13	.359141	8.95	.988342	.50	.370799	9.47	.629201	47
14	.359678	8.95	.988312	.50	.371367	9.43	.628633	46
15	.360215	8.95	.988282	.50	.371933	9.43	.628067	45
16	.360752	8.92	.988252	.48	.372499	9.42	.627501	44
17	.361287	8.92	.988223	.50	.373064	9.42	.626936	43
18	.361822	8.90	.988193	.50	.373629	9.40	.626371	42
19	.362356	8.88	.988163	.50	.374193	9.38	.625807	41
20	.362889	8.88	.988133	.50	.374756	9.38	.625244	40
21	9.363422	8.87	9.988103	.50	9.375319	9.37	10.624681	39
22	.363954	8.85	.988073	.50	.375881	9.35	.624119	38
23	.364485	8.85	.988043	.50	.376442	9.35	.623558	37
24	.365016	8.83	.988013	.50	.377003	9.33	.622997	36
25	.365546	8.82	.987983	.50	.377563	9.32	.622437	35
26	.366075	8.82	.987953	.52	.378122	9.32	.621878	34
27	.366604	8.78	.987922	.50	.378681	9.30	.621319	33
28	.367131	8.80	.987892	.50	.379239	9.30	.620761	32
29	.367659	8.77	.987862	.50	.379797	9.28	.620203	31
30	.368185	8.77	.987832	.52	.380354	9.27	.619646	30
31	9.368711	8.75	9.987801	.50	9.380910	9.27	10.619090	29
32	.369236	8.75	.987771	.52	.381466	9.23	.618534	28
33	.369761	8.72	.987740	.50	.382020	9.25	.617980	27
34	.370285	8.72	.987710	.52	.382575	9.23	.617425	26
35	.370808	8.70	.987679	.50	.383129	9.22	.616871	25
36	.371330	8.70	.987649	.52	.383682	9.20	.616318	24
37	.371852	8.68	.987618	.50	.384234	9.20	.615766	23
38	.372373	8.68	.987588	.52	.384786	9.18	.615214	22
39	.372894	8.67	.987557	.52	.385337	9.18	.614663	21
40	.373414	8.65	.987526	.50	.385888	9.17	.614112	20
41	9.373933	8.65	9.987496	.52	9.386438	9.15	10.613562	19
42	.374452	8.63	.987465	.52	.386987	9.15	.613013	18
43	.374970	8.62	.987434	.52	.387536	9.13	.612464	17
44	.375487	8.60	.987403	.52	.388084	9.12	.611916	16
45	.376003	8.60	.987372	.52	.388631	9.12	.611369	15
46	.376519	8.60	.987341	.52	.389178	9.10	.610822	14
47	.377035	8.57	.987310	.52	.389724	9.10	.610276	13
48	.377549	8.57	.987279	.52	.390270	9.08	.609730	12
49	.378063	8.57	.987248	.52	.390815	9.08	.609185	11
50	.378577	8.53	.987217	.52	.391360	9.05	.608640	10
51	9·379089	8.53	9.987186	.52	9.391903	9.07	10.608097	9
52	.379601	8.53	.987155	.52	.392447	9.03	.607553	8
53	.380113	8.52	.987124	.53	.392989	9.03	.607011	7
54	.380624	8.50	.987092	.52	.393531	9.03	.606469	6
55	.381134	8.48	.987061	.52	.394073	9.02	.605927	5
56	.381643	8.48	.987030	.53	.394614	9.00	.605386	4
57	.382152	8.48	.986998	.52	.395154	9.00	.604846	3
58	.382661	8.45	.986967	.52	.395694	8.98	.604306	2
59	.383168	8.45	.986936	.53	.396233	8.97	.603767	1
60	9.383675		9.986904		9.396771		10.603229	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.383675	8.45	9.986904	.52	9.396771	8.97	10.603229	60
1	.384182	8.42	.986873	.53	.397309	8.95	.602691	59
2	.384687	8.42	.986841	.53	.397846	8.95	.602154	58
3	.385192	8.42	.986809	.52	.398383	8.93	.601617	57
4	.385697	8.40	.986778	.53	.398919	8.93	.601081	56
5	.386201	8.38	.986746	.53	.399455	8.92	.600545	55
6	.386704	8.38	.986714	.52	.399990	8.90	.600010	54
7	.387207	8.37	.986683	.53	.400524	8.90	.599476	53
8	.387709	8.35	.986651	.53	.401058	8.88	.598942	52
9	.388210	8.35	.986619	.53	.401591	8.88	.598409	51
10	.388711	8.33	.986587	.53	.402124	8.87	.597876	50
11	9.389211	8.33	9.986555	.53	9.402656	8.85	10.597344	49
12	.389711	8.32	.986523	.53	.403187	8.85	.596813	48
13	.390210	8.30	.986491	.53	.403718	8.85	.596282	47
14	.390708	8.30	.986459	.53	.404249	8.82	.595751	46
15	.391206	8.28	.986427	.53	.404778	8.83	.595222	45
16	.391703	8.27	.986395	.53	.405308	8.80	.594692	44
17	.392199	8.27	.986363	.53	.405836	8.80	.594164	43
18	.392695	8.27	.986331	.53	.406364	8.80	.593636	42
19	.393191	8.23	.986299	.55	.406892	8.78	.593108	41
20	.393685	8.23	.986266	.53	.407419	8.77	.592581	40
21	9.394179	8.23	9.986234	.53	9.407945	8.77	10.592055	39
22	.394673	8.22	.986202	.55	.408471	8.75	.591529	38
23	.395166	8.20	.986169	.53	.408996	8.75	.591004	37
24	.395658	8.20	.986137	.55	.409521	8.73	.590479	36
25	.396150	8.18	.986104	.53	.410045	8.73	.589955	35
26	.396641	8.18	.986072	.55	.410569	8.72	.589431	34
27	.397132	8.15	.986039	.53	.411092	8.72	.588908	33
28	.397621	8.17	.986007	.55	.411615	8.70	.588385	32
29	.398111	8.15	.985974	.53	.412137	8.68	.587863	31
30	.398600	8.13	.985942	.55	.412658	8.68	.587342	30
31	9.399088	8.12	9.985909	.55	9.413179	8.67	10.586821	29
32	.399575	8.12	.985876	.55	.413699	8.67	.586301	28
33	.400062	8.12	.985843	.53	.414219	8.65	.585781	27
34	.400549	8.10	.985811	.55	.414738	8.65	.585262	26
35	.401035	8.08	.985778	.55	.415257	8.63	.584743	25
36	.401520	8.08	.985745	.55	.415775	8.63	.584225	24
37	.402005	8.07	.985712	.55	.416293	8.62	.583707	23
38	.402489	8.05	.985679	.55	.416810	8.60	.583190	22
39	.402972	8.05	.985646	.55	.417326	8.60	.582674	21
40	.403455	8.05	.985613	.55	.417842	8.60	.582158	20
41	9.403938	8.03	9.985580	.55	9.418358	8.58	10.581642	19
42	.404420	8.02	.985547	.55	.418873	8.57	.581127	18
43	.404901	8.02	.985514	.57	.419387	8.57	.580613	17
44	.405382	8.00	.985480	.55	.419901	8.57	.580099	16
45	.405862	7.98	.985447	.55	.420415	8.55	.579585	15
46	.406341	7.98	.985414	.55	.420927	8.55	.579073	14
47	.406820	7.98	.985381	.57	.421440	8.53	.578560	13
48	.407299	7.97	.985347	.55	.421952	8.52	.578048	12
49	.407777	7.95	.985314	.57	.422463	8.52	.577537	11
50	.408254	7.95	.985280	.55	.422974	8.50	.577026	10
51	9.408731	7.93	9.985247	.57	9.423484	8.48	10.576516	9
52	.409207	7.93	.985213	.55	.423993	8.50	.576007	8
53	.409682	7.92	.985180	.57	.424503	8.47	.575497	7
54	.410157	7.92	.985146	.55	.425011	8.47	.574989	6
55	.410632	7.90	.985113	.57	.425519	8.47	.574481	5
56	.411106	7.88	.985079	.57	.426027	8.45	.573973	4
57	.411579	7.88	.985045	.57	.426534	8.45	.573466	3
58	.412052	7.87	.985011	.55	.427041	8.43	.572959	2
59	.412524	7.87	.984978	.57	.427547	8.42	.572453	1
60	9.412996		9.984944		9.428052		10.571948	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.412996	7.85	9.984944	.57	9.428052	8.43	10.571948	60
1	.413467	7.85	.984910	.57	.428558	8.40	.571442	59
2	.413938	7.83	.984876	.57	.429062	8.40	.570938	58
3	.414408	7.83	.984842	.57	.429566	8.40	.570434	57
4	.414878	7.82	.984808	.57	.430070	8.38	.569930	56
5	.415347	7.80	.984774	.57	.430573	8.37	.569427	55
6	.415815	7.80	.984740	.57	.431075	8.37	.568925	54
7	.416283	7.80	.984706	.57	.431577	8.37	.568423	53
8	.416751	7.77	.984672	.57	.432079	8.35	.567921	52
9	.417217	7.78	.984638	.58	.432580	8.33	.567420	51
10	.417684	7.77	.984603	.57	.433080	8.33	.566920	50
11	9.418150	7.75	9.984569	.57	9.433580	8.33	10.566420	49
12	.418615	7.73	.984535	.58	.434080	8.32	.565920	48
13	.419079	7.75	.984500	.57	.434579	8.32	.565421	47
14	.419544	7.72	.984466	.57	.435078	8.30	.564922	46
15	.420007	7.72	.984432	.58	.435576	8.28	.564424	45
16	.420470	7.72	.984397	.57	.436073	8.28	.563927	44
17	.420933	7.70	.984363	.58	.436570	8.28	.563430	43
18	.421395	7.70	.984328	.57	.437067	8.27	.562933	42
19	.421857	7.68	.984294	.58	.437563	8.27	.562437	41
20	.422318	7.67	.984259	.58	.438059	8.25	.561941	40
21	9.422778	7.67	9.984224	.57	9.438554	8.23	10.561446	39
22	.423238	7.65	.984190	.58	.439048	8.25	.560952	38
23	.423697	7.65	.984155	.58	.439543	8.22	.560457	37
24	.424156	7.65	.984120	.58	.440036	8.22	.559964	36
25	.424615	7.63	.984085	.58	.440529	8.22	.559471	35
26	.425073	7.62	.984050	.58	.441022	8.20	.558978	34
27	.425530	7.62	.984015	.57	.441514	8.20	.558486	33
28	425987	7.60	.983981	.58	.442006	8.18	.557994	32
29	.426443	7.60	.983946	.58	.442497	8.18	.557503	31
30	.426899	7.58	.983911	.60	.442988	8.18	.557012	30
31	9.427354	7.58	9.983875	.58	9.443479	8.15	10.556521	29
32	.427809	7.57	.983840	.58	.443968	8.17	.556032	28
33	.428263	7.57	.983805	.58	.444458	8.15	.555542	27
34	.428717	7.55	.983770	.58	.444947	8.13	.555053	26
35	.429170	7.55	.983735	.58	.445435	8.13	.554565	25
36	.429623	7.53	.983700	.60	.445923	8.13	.554077	24
37	.430075	7.53	.983664	.58	.446411	8.12	.553589	23
38	.430527	7.52	.983629	.58	.446898	8.10	.553102	22
39	.430978	7.52	.983594	.60	.447384	8.10	.552616	21
40	.431429	7.50	.983558	.58	.447870	8.10	.552130	20
41	9.431879	7.50	9.983523	.60	9.448356	8.08	10.551644	19
42	.432329	7.48	.983487	.58	.448841	8.08	.551159	18
43	.432778	7.47	.983452	.60	.449326	8.07	.550674	17
44	.433226	7.48	.983416	.58	.449810	8.07	.550190	16
45	.433675	7.45	.983381	.60	.450294	8.05	.549706	15
46	.434122	7.45	.983345	.60	.450777	8.05	.549223	14
47	.434569	7.45	.983309	.60	.451260	8.05	.548740	13
48	.435016	7.43	.983273	.58	.451743	8.03	.548257	12
49	.435462	7.43	.983238	.60	.452225	8.02	.547775	11
50	.435908	7.42	.983202	.60	.452706	8.02	.547294	10
51	9.436353	7.42	9.983166	.60	9.453187	8.02	10.546813	9
52	.436798	7.40	.983130	.60	.453668	8.00	.546332	8
53	.437242	7.40	.983094	.60	.454148	8.00	.545852	7
54	.437686	7.38	.983058	.60	.454628	7.98	.545372	6
55	.438129	7.38	.983022	.60	.455107	7.98	.544893	5
56	.438572	7.37	.982986	.60	.455586	7.97	.544414	4
57	.439014	7.37	.982950	.60	.456064	7.97	.543936	3
58	.439456	7.35	.982914	.60	.456542	7.95	.543458	2
59	.439897	7.35	.982878	.60	.457019	7.95	.542981	1
60	9.440338		9.982842		9.457496		10.542504	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.440338	7.33	9.982842	.62	9.457496	7.95	10.542504	60
1	.440778	7.33	.982805	.60	.457973	7.93	.542027	59
2	.441218	7.33	.982769	.60	.458449	7.93	.541551	58
3	.441658	7.30	.982733	.62	.458925	7.92	.541075	57
4	.442096	7.32	.982696	.60	.459400	7.92	.540600	56
5	.442535	7.30	.982660	.60	.459875	7.90	.540125	55
6	.442973	7.28	.982624	.62	.460349	7.90	.539651	54
7	.443410	7.28	.982587	.60	.460823	7.90	.539177	53
8	.443847	7.28	.982551	.62	.461297	7.88	.538703	52
9	.444284	7.27	.982514	.62	.461770	7.87	.538230	51
10	.444720	7.25	.982477	.60	.462242	7.88	.537758	50
11	9.445155	7.25	9.982441	.62	9.462715	7.85	10.537285	49
12	.445590	7.25	.982404	.62	.463186	7.87	.536814	48
13	.446025	7.23	.982367	.60	.463658	7.83	.536342	47
14	.446459	7.23	.982331	.62	.464128	7.85	.535872	46
15	.446893	7.22	.982294	.62	.464599	7.83	.535401	45
16	.447326	7.22	.982257	.62	.465069	7.83	.534931	44
17	.447759	7.20	.982220	.62	.465539	7.82	.534461	43
18	.448191	7.20	.982183	.62	.466008	7.82	.533992	42
19	.448623	7.18	.982146	.62	.466477	7.80	.533523	41
20	.449054	7.18	.982109	.62	.466945	7.80	.533055	40
21	9.449485	7.17	9.982072	.62	9.467413	7.78	10.532587	39
22	.449915	7.17	.982035	.62	.467880	7.78	.532120	38
23	.450345	7.17	.981998	.62	.468347	7.78	.531653	37
24	.450775	7.15	.981961	.62	.468814	7.77	.531186	36
25	.451204	7.13	.981924	.63	.469280	7.77	.530720	35
26	.451632	7.13	.981886	.62	.469746	7.75	.530254	34
27	.452060	7.13	.981849	.62	.470211	7.75	.529789	33
28	.452488	7.12	.981812	.63	.470676	7.75	.529324	32
29	.452915	7.12	.981774	.62	.471141	7.73	.528859	31
30	.453342	7.10	.981737	.62	.471605	7.73	.528395	30
31	9.453768	7.10	9.981700	.63	9.472069	7.72	10.527931	29
32	.454194	7.08	.981662	.62	.472532	7.72	527468	28
33	.454619	7.08	.981625	.63	.472995	7.70	.527005	27
34	.455044	7.08	.981587	.63	.473457	7.70	.526543	26
35	.455469	7.07	.981549	.62	.473919	7.70	.526081	25
36	.455893	7.05	.981512	.63	.474381	7.68	.525619	24
37	.456316	7.05	.981474	.63	.474842	7.68	.525158	23
38	.456739	7.05	.981436	.62	.475303	7.67	.524697	22
39	.457162	7.03	.981399	.63	.475763	7.67	.524237	21
40	.457584	7.03	.981361	.63	.476223	7.67	.523777	20
41	9.458006	7.02	9.981323	.63	9.476683	7.65	10.523317	19
42	.458427	7.02	.981285	.63	.477142	7.65	.522858	18
43	.458848	7.00	.981247	.63	.477601	7.63	.522399	17
44	.459268	7.00	.981209	.63	.478059	7.63	.521941	16
45	.459688	7.00	.981171	.63	.478517	7.63	.521483	15
46	.460108	6.98	.981133	.63	.478975	7.62	.521025	14
47	.460527	6.98	.981095	.63	.479432	7.62	.520568	13
48	.460946	6.97	.981057	.63	.479889	7.60	.520111	12
49	.461364	6.97	.981019	.63	.480345	7.60	.519655	11
50	.461782	6.95	.980981	.65	.480801	7.60	.519199	10
51	9.462199	6.95	9.980942	.63	9.481257	7.58	10.518743	9
52	.462616	6.93	.980904	.63	.481712	7.58	.518288	8
53	.463032	6.93	.980866	.65	.482167	7.57	.517833	7
54	.463448	6.93	.980827	.63	.482621	7.57	.517379	6
55	.463864	6.92	.980789	.65	.483075	7.57	.516925	5
56	.464279	6.92	.980750	.63	.483529	7.55	.516471	4
57	.464694	6.90	.980712	.65	.483982	7.55	.516018	3
58	.465108	6.90	.980673	.63	.484435	7.53	.515565	2
59	.465522	6.88	.980635	.65	.484887	7.53	.515113	1
60	9.465935		9.980596		9.485339		10.514661	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.465935	6.88	9.980596	.63	9.485339	7.53	10.514661	60
1	.466348	6.88	.980558	.65	.485791	7.52	.514209	59
2	.466761	6.87	.980519	.65	.486242	7.52	.513758	58
3	.467173	6.87	.980480	.63	.486693	7.50	.513307	57
4	.467585	6.85	.980442	.65	.487143	7.50	.512857	56
5	.467996	6.85	.980403	.65	.487593	7.50	.512407	55
6	.468407	6.83	.980364	.65	.488043	7.48	.511957	54
7	.468817	6.83	.980325	.65	.488492	7.48	.511508	53
8	.469227	6.83	.980286	.65	.488941	7.48	.511059	52
9	.469637	6.82	.980247	.65	.489390	7.47	.510610	51
10	.470046	6.82	.980208	.65	.489838	7.47	.510162	50
11	9.470455	6.80	9.980169	.65	9.490286	7.45	10.509714	49
12	.470863	6.80	.980130	.65	.490733	7.45	.509267	48
13	.471271	6.80	.980091	.65	.491180	7.45	.508820	47
14	.471679	6.78	.980052	.67	.491627	7.43	.508373	46
15	.472086	6.77	.980012	.65	.492073	7.43	.507927	45
16	.472492	6.77	.979973	.65	.492519	7.43	.507481	44
17	.472898	6.77	.979934	.65	.492965	7.42	.507035	43
18	.473304	6.77	.979895	.67	.493410	7.40	.506590	42
19	.473710	6.75	.979855	.65	.493854	7.42	.506146	41
20	.474115	6.73	.979816	.67	.494299	7.40	.505701	40
21	9.474519	6.73	9.979776	.65	9.494743	7.38	10.505257	39
22	.474923	6.73	.979737	.67	.495186	7.40	.504814	38
23	.475327	6.72	.979697	.65	.495630	7.38	.504370	37
24	.475730	6.72	.979658	.67	.496073	7.37	.503927	36
25	.476133	6.72	.979618	.65	.496515	7.37	.503485	35
26	.476536	6.70	.979579	.67	.496957	7.37	.503043	34
27	.476938	6.70	.979539	.67	.497399	7.37	.502601	33
28	.477340	6.68	.979499	.67	.497841	7.35	.502159	32
29	.477741	6.68	.979459	.65	.498282	7.33	.501718	31
30	.478142	6.67	.979420	.67	.498722	7.35	.501278	30
31	9.478542	6.67	9.979380	.67	9.499163	7.33	10.500837	29
32	.478942	6.67	.979340	.67	.499603	7.32	.500397	28
33	.479342	6.65	.979300	.67	.500042	7.32	.499958	27
34	.479741	6.65	.979260	.67	.500481	7.32	.499519	26
35	.480140	6.65	.979220	.67	.500920	7.32	.499080	25
36	.480539	6.63	.979180	.67	.501359	7.30	.498641	24
37	.480937	6.62	.979140	.67	.501797	7.30	.498203	23
38	.481334	6.62	.979100	.68	.502235	7.28	.497765	22
39	.481731	6.62	.979059	.67	.502672	7.28	.497328	21
40	.482128	6.62	.979019	.67	.503109	7.28	.496891	20
41	9.482525	6.60	9.978979	.67	9.503546	7.27	10.496454	19
42	.482921	6.58	.978939	.68	.503982	7.27	.496018	18
43	.483316	6.60	.978898	.67	.504418	7.27	.495582	17
44	.483712	6.58	.978858	.68	.504854	7.25	.495146	16
45	.484107	6.57	.978817	.67	.505289	7.25	.494711	15
46	.484501	6.57	.978777	.67	.505724	7.25	.494276	14
47	.484895	6.57	.978737	.68	.506159	7.23	.493841	13
48	.485289	6.55	.978696	.68	.506593	7.23	.493407	12
49	.485682	6.55	.978655	.67	.507027	7.23	.492973	11
50	.486075	6.53	.978615	.68	.507460	7.22	.492540	10
51	9.486467	6.55	9.978574	.68	9.507893	7.22	10.492107	9
52	.486860	6.52	.978533	.67	.508326	7.22	.491674	8
53	.487251	6.53	.978493	.68	.508759	7.20	.491241	7
54	.487643	6.52	.978452	.68	.509191	7.18	.490809	6
55	.488034	6.50	.978411	.68	.509622	7.20	.490378	5
56	.488424	6.50	.978370	.68	.510054	7.18	.489946	4
57	.488814	6.50	978329	.68	.510485	7.18	.489515	3
58	.489204	6.48	.978288	.68	.510916	7.17	.489084	2
59	.489593	6.48	.978247	.68	.511346	7.17	.488654	1
60	9.489982		9.978206		9.511776		10.488224	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.489982	6.48	9.978206	.68	9.511776	7.17	10.488224	60
1	.490371	6.47	.978165	.68	.512206	7.15	.487794	59
2	.490759	6.47	.978124	.68	.512635	7.15	.487365	58
3	.491147	6.47	.978083	.68	.513064	7.15	.486936	57
4	.491535	6.45	.978042	.68	.513493	7.13	.486507	56
5	.491922	6.43	.978001	.70	.513921	7.13	.486079	55
6	.492308	6.45	.977959	.68	.514349	7.13	.485651	54
7	.492695	6.43	.977918	.68	.514777	7.12	.485223	53
8	.493081	6.42	.977877	.70	.515204	7.12	.484796	52
9	.493466	6.42	.977835	.68	.515631	7.10	.484369	51
10	.493851	6.42	.977794	.70	.516057	7.12	.483943	50
11	9.494236	6.42	9.977752	.68	9.516484	7.10	10.483516	49
12	.494621	6.40	.977711	.70	.516910	7.08	.483090	48
13	.495005	6.38	.977669	.68	.517335	7.10	.482665	47
14	.495388	6.40	.977628	.70	.517761	7.08	.482239	46
15	.495772	6.37	.977586	.70	.518186	7.07	.481814	45
16	.496154	6.38	.977544	.68	.518610	7.07	.481390	44
17	.496537	6.37	.977503	.70	.519034	7.07	.480966	43
18	.496919	6.37	.977461	.70	.519458	7.07	.480542	42
19	.497301	6.35	.977419	.70	.519882	7.05	.480118	41
20	.497682	6.35	.977377	.70	.520305	7.05	.479695	40
21	9.498064	6.33	9.977335	.70	9.520728	7.05	10.479272	39
22	.498444	6.35	.977293	.70	.521151	7.03	.478849	38
23	.498825	6.32	.977251	.70	.521573	7.03	.478427	37
24	.499204	6.33	.977209	.70	.521995	7.03	.478005	36
25	.499584	6.32	.977167	.70	.522417	7.02	.477583	35
26	.499963	6.32	.977125	.70	.522838	7.02	.477162	34
27	.500342	6.32	.977083	.70	.523259	7.02	.476741	33
28	.500721	6.30	.977041	.70	.523680	7.00	.476320	32
29	.501099	6.28	.976999	.70	.524100	7.00	.475900	31
30	.501476	6.30	.976957	.72	.524520	7.00	.475480	30
31	9.501854	6.28	9.976914	.70	9.524940	6.98	10.475060	29
32	.502231	6.27	.976872	.70	.525359	6.98	.474641	28
33	.502607	6.28	.976830	.72	.525778	6.98	.474222	27
34	.502984	6.27	.976787	.70	.526197	6.97	.473803	26
35	.503360	6.25	.976745	.72	.526615	6.97	.473385	25
36	.503735	6.25	.976702	.70	.527033	6.97	.472967	24
37	.504110	6.25	.976660	.72	.527451	6.95	.472549	23
38	.504485	6.25	.976617	.72	.527868	6.95	.472132	22
39	.504860	6.23	.976574	.70	.528285	6.95	.471715	21
40	.505234	6.23	.976532	.72	.528702	6.95	.471298	20
41	9.505608	6.22	9.976489	.72	9.529119	6.93	10.470881	19
42	.505981	6.22	.976446	.70	.529535	6.93	.470465	18
43	.506354	6.22	.976404	.72	.529951	6.92	.470049	17
44	.506727	6.20	.976361	.72	.530366	6.92	.469634	16
45	.507099	6.20	.976318	.72	.530781	6.92	.469219	15
46	.507471	6.20	.976275	.72	.531196	6.92	.468804	14
47	.507843	6.18	.976232	.72	.531611	6.90	.468389	13
48	.508214	6.18	.976189	.72	.532025	6.90	.467975	12
49	.508585	6.18	.976146	.72	.532439	6.90	.467561	11
50	.508956	6.17	.976103	.72	.532853	6.88	.467147	10
51	9.509326	6.17	9.976060	.72	9.533266	6.88	10.466734	9
52	.509696	6.15	.976017	.72	.533679	6.88	.466321	8
53	.510065	6.15	.975974	.73	.534092	6.87	.465908	7
54	.510434	6.15	.975930	.72	.534504	6.87	.465496	6
55	.510803	6.15	.975887	.72	.534916	6.87	.465084	5
56	.511172	6.13	.975844	.73	.535328	6.85	.464672	4
57	.511540	6.12	.975800	.72	.535739	6.85	.464261	3
58	.511907	6.13	.975757	.72	.536150	6.85	.463850	2
59	.512275	6.12	.975714	.73	.536561	6.85	.463439	1
60	9.512642		9.975670		9.536972		10.463028	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.512642	6.12	9.975670	.72	9.536972	6.83	10.463028	60
1	.513009	6.10	.975627	.73	.537382	6.83	.462618	59
2	.513375	6.10	.975583	.73	.537792	6.83	.462208	58
3	.513741	6.10	.975539	.72	.538202	6.82	.461798	57
4	.514107	6.08	.975496	.73	.538611	6.82	.461389	56
5	.514472	6.08	.975452	.73	.539020	6.82	.460980	55
6	.514837	6.08	.975408	.72	.539429	6.80	.460571	54
7	.515202	6.07	.975365	.73	.539837	6.80	.460163	53
8	.515566	6.07	.975321	.73	.540245	6.80	.459755	52
9	.515930	6.07	.975277	.73	.540653	6.80	.459347	51
10	.516294	6.05	.975233	.73	.541061	6.78	.458939	50
11	9.516657	6.05	9.975189	.73	9.541468	6.78	10.458532	49
12	.517020	6.03	.975145	.73	.541875	6.77	.458125	48
13	.517382	6.05	.975101	.73	.542281	6.78	.457719	47
14	.517745	6.03	.975057	.73	.542688	6.77	.457312	46
15	.518107	6.02	.975013	.73	.543094	6.75	.456906	45
16	.518468	6.02	.974969	.73	.543499	6.77	.456501	44
17	.518829	6.02	.974925	.75	.543905	6.75	.456095	43
18	.519190	6.02	.974880	.73	.544310	6.75	.455690	42
19	.519551	6.00	.974836	.73	.544715	6.73	.455285	41
20	.519911	6.00	.974792	.73	.545119	6.75	.454881	40
21	9.520271	6.00	9.974748	.75	9.545524	6.73	10.454476	39
22	.520631	5.98	.974703	.73	.545928	6.72	.454072	38
23	.520990	5.98	.974659	.75	.546331	6.73	.453669	37
24	.521349	5.97	.974614	.73	.546735	6.72	.453265	36
25	.521707	5.98	.974570	.75	.547138	6.70	.452862	35
26	.522066	5.97	.974525	.73	.547540	6.72	.452460	34
27	.522424	5.95	.974481	.75	.547943	6.70	.452057	33
28	.522781	5.95	.974436	.75	.548345	6.70	.451655	32
29	.523138	5.95	.974391	.73	.548747	6.70	.451253	31
30	.523495	5.95	.974347	.75	.549149	6.68	.450851	30
31	9.523852	5.93	9.974302	.75	9.549550	6.68	10.450450	29
32	.524208	5.93	.974257	.75	.549951	6.68	.450049	28
33	.524564	5.93	.974212	.75	.550352	6.67	.449648	27
34	.524920	5.92	.974167	.75	.550752	6.68	.449248	26
35	.525275	5.92	.974122	.75	.551153	6.65	.448847	25
36	.525630	5.90	.974077	.75	.551552	6.67	.448448	24
37	.525984	5.92	.974032	.75	.551952	6.65	.448048	23
38	.526339	5.90	.973987	.75	.552351	6.65	.447649	22
39	.526693	5.88	.973942	.75	.552750	6.65	.447250	21
40	.527046	5.90	.973897	.75	.553149	6.65	.446851	20
41	9.527400	5.88	9.973852	.75	9.553548	6.63	10.446452	19
42	.527753	5.87	.973807	.77	.553946	6.63	.446054	18
43	.528105	5.88	.973761	.75	.554344	6.62	.445656	17
44	.528458	5.87	.973716	.75	.554741	6.63	.445259	16
45	.528810	5.85	.973671	.77	.555139	6.62	.444861	15
46	.529161	5.87	.973625	.75	.555536	6.62	.444464	14
47	.529513	5.85	.973580	.75	.555933	6.60	.444067	13
48	.529864	5.85	.973535	.77	.556329	6.60	.443671	12
49	.530215	5.83	.973489	.75	.556725	6.60	.443275	11
50	.530565	5.83	.973444	.77	.557121	6.60	.442879	10
51	9.530915	5.83	9.973398	.77	9.557517	6.60	10.442483	9
52	.531265	5.82	.973352	.75	.557913	6.58	.442087	8
53	.531614	5.82	.973307	.77	.558308	6.58	.441692	7
54	.531963	5.82	.973261	.77	.558703	6.57	.441297	6
55	.532312	5.82	.973215	.77	.559097	6.57	.440903	5
56	.532661	5.80	.973169	.75	.559491	6.57	.440509	4
57	.533009	5.80	.973124	.77	.559885	6.57	.440115	3
58	.533357	5.78	.973078	.77	.560279	6.57	.439721	2
59	.533704	5.80	.973032	.77	.560673	6.55	.439327	1
60	9.534052		9.972986		9.561066		10.438934	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.534052	5.78	9.972986	.77	9 561066	6 55	10.438934	60
1	.534399	5.77	.972940	.77	.561459	6 53	.438541	59
2	.534745	5.78	.972894	.77	561851	6.55	438149	58
3	.535092	5.77	.972848	.77	562244	6.53	.437756	57
4	.535438	5.75	972802	.78	.562636	6.53	.437364	56
5	.535783	5.77	972755	.77	.563028	6 52	.436972	55
6	.536129	5 75	.972709	.77	563419	6 53	.436581	54
7	.536474	5.73	.972663	.77	563811	6 52	.436189	53
8	.536818	5.75	972617	.78	.564202	6.52	.435798	52
9	.537163	5.73	.972570	.77	.564593	6 50	.435407	51
10	.537507	5.73	.972524	.77	.564983	6.50	.435017	50
11	9.537851	5.72	9.972478	.78	9.565373	6.50	10.434627	49
12	538194	5.73	972431	.77	565763	6 50	.434237	48
13	.538538	5.70	972385	.78	.566153	6.48	.433847	47
14	538880	5.72	972338	.78	566542	6.50	.433458	46
15	.539223	5.70	.972291	.77	.566932	6.47	.433068	45
16	539565	5.70	.972245	.78	.567320	6.48	.432680	44
17	.539907	5.68	.972198	.78	567709	6.48	.432291	43
18	.540249	5.68	.972151	.77	.568098	6.47	.431902	42
19	.540590	5.68	.972105	.78	568486	6.45	.431514	41
20	.540931	5.68	.972058	.78	.568873	6.47	.431127	40
21	9.541272	5.68	9.972011	.78	9.569261	6.45	10.430739	39
22	.541613	5.67	.971964	.78	.569648	6.45	.430352	38
23	.541953	5.67	971917	.78	.570035	6.45	.429965	37
24	.542293	5.65	.971870	.78	.570422	6.45	.429578	36
25	.542632	5.65	.971823	.78	.570809	6.43	.429191	35
26	.542971	5.65	.971776	.78	.571195	6 43	.428805	34
27	.543310	5.65	.971729	.78	.571581	6.45	.428419	33
28	.543649	5.63	.971682	.78	.571967	6.42	.428033	32
29	.543987	5.63	.971635	.78	.572352	6.43	.427648	31
30	.544325	5.63	.971588	.80	572738	6.42	.427262	30
31	9.544663	5.62	9.971540	.78	9.573123	6 40	10.426877	29
32	.545000	5.63	.971493	.78	.573507	6.42	.426493	28
33	.545338	5.60	.971446	.80	.573892	6.40	.426108	27
34	.545674	5.62	.971398	.78	.574276	6.40	.425724	26
35	.546011	5.60	.971351	.80	.574660	6.40	.425340	25
36	.546347	5.60	.971303	.78	.575044	6.38	.424956	24
37	.546683	5.60	.971256	.80	.575427	6 38	.424573	23
38	.547019	5.58	.971208	.78	.575810	6.38	.424190	22
39	.547354	5.58	.971161	.80	.576193	6.38	.423807	21
40	.547689	5.58	.971113	.78	.576576	6.38	.423424	20
41	9.548024	5.58	9.971066	.80	9.576959	6.37	10.423041	19
42	.548359	5 57	.971018	.80	.577341	6.37	.422659	18
43	.548693	5.57	.970970	.80	.577723	6.35	.422277	17
44	.549027	5.55	.970922	.80	.578104	6.37	.421896	16
45	.549360	5.55	.970874	.78	.578486	6.35	.421514	15
46	.549693	5.55	.970827	.80	.578867	6.35	.421133	14
47	.550026	5.55	.970779	.80	.579248	6.35	.420752	13
48	.550359	5.55	.970731	.80	.579629	6.33	.420371	12
49	.550692	5.53	.970683	.80	.580009	6.33	.419991	11
50	.551024	5.53	.970635	.82	580389	6.33	.419611	10
51	9.551356	5.52	9.970586	.80	9.580769	6.33	10.419231	9
52	.551687	5.52	.970538	.80	.581149	6.32	.418851	8
53	.552018	5.52	.970490	.80	.581528	6.32	.418472	7
54	.552349	5.52	.970442	.80	581907	6.32	.418093	6
55	.552680	5.50	.970394	.82	.582286	6.32	.417714	5
56	.553010	5.52	.970345	.80	.582665	6.32	.417335	4
57	.553341	5.48	.970297	.80	.583044	6.30	.416956	3
58	.553670	5.50	.970249	.82	.583422	6.30	.416578	2
59	.554000	5.48	.970200	.80	.583800	6.28	.416200	1
60	9.554329		9.970152		9.584177		10.415823	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.554329	5.48	9.970152	.82	9.584177	6.30	10.415823	60
1	.554658	5.48	.970103	.80	.584555	6.28	.415445	59
2	.554987	5.47	.970055	.82	.584932	6.28	.415068	58
3	.555315	5.47	.970006	.82	.585309	6.28	.414691	57
4	.555643	5.47	.969957	.80	.585686	6.27	.414314	56
5	.555971	5.47	.969909	.82	.586062	6.28	.413938	55
6	.556299	5.45	.969860	.82	.586439	6.27	.413561	54
7	.556626	5.45	.969811	.82	.586815	6.25	.413185	53
8	.556953	5.45	.969762	.80	.587190	6.27	.412810	52
9	.557280	5.43	.969714	.82	.587566	6.25	.412434	51
10	.557606	5.43	.969665	.82	.587941	6.25	.412059	50
11	9.557932	5.43	9.969616	.82	9.588316	6.25	10.411684	49
12	.558258	5.42	.969567	.82	.588691	6.25	.411309	48
13	.558583	5.43	.969518	.82	.589066	6.23	.410934	47
14	.558909	5.42	.969469	.82	.589440	6.23	.410560	46
15	.559234	5.40	.969420	.83	.589814	6.23	.410186	45
16	.559558	5.42	.969370	.82	.590188	6.23	.409812	44
17	.559883	5.40	.969321	.82	.590562	6.22	.409438	43
18	.560207	5.40	.969272	.82	.590935	6.22	.409065	42
19	.560531	5.40	.969223	.83	.591308	6.22	.408692	41
20	.560855	5.38	.969173	.82	.591681	6.22	.408319	40
21	9.561178	5.38	9.969124	.82	9.592054	6.20	10.407946	39
22	.561501	5.38	.969075	.83	.592426	6.22	.407574	38
23	.561824	5.37	.969025	.82	.592799	6.20	.407201	37
24	.562146	5.37	.968976	.83	.593171	6.18	.406829	36
25	.562468	5.37	.968926	.82	.593542	6.20	.406458	35
26	.562790	5.37	.968877	.83	.593914	6.18	.406086	34
27	.563112	5.35	.968827	.83	.594285	6.18	.405715	33
28	.563433	5.37	.968777	.82	.594656	6.18	.405344	32
29	.563755	5.33	.968728	.83	.595027	6.18	.404973	31
30	.564075	5.35	.968678	.83	.595398	6.17	.404602	30
31	9.564396	5.33	9.968628	.83	9.595768	6.17	10.404232	29
32	.564716	5.33	.968578	.83	.596138	6.17	.403862	28
33	.565036	5.33	.968528	.82	.596508	6.17	.403492	27
34	.565356	5.33	.968479	.83	.596878	6.15	.403122	26
35	.565676	5.32	.968429	.83	.597247	6.15	.402753	25
36	.565995	5.32	.968379	.83	.597616	6.15	.402384	24
37	.566314	5.30	.968329	.85	.597985	6.15	.402015	23
38	.566632	5.32	.968278	.83	.598354	6.13	.401646	22
39	.566951	5.30	.968228	.83	.598722	6.15	.401278	21
40	.567269	5.30	.968178	.83	.599091	6.13	.400909	20
41	9.567587	5.28	9.968128	.83	9.599459	6.13	10.400541	19
42	.567904	5.30	.968078	.85	.599827	6.12	.400173	18
43	.568222	5.28	.968027	.83	.600194	6.13	.399806	17
44	.568539	5.28	.967977	.83	.600562	6.12	.399438	16
45	.568856	5.27	.967927	.85	.600929	6.12	.399071	15
46	.569172	5.27	.967876	.83	.601296	6.12	.398704	14
47	.569488	5.27	.967826	.85	.601663	6.10	.398337	13
48	.569804	5.27	.967775	.83	.602029	6.10	.397971	12
49	.570120	5.25	.967725	.85	.602395	6.10	.397605	11
50	.570435	5.27	.967674	.83	.602761	6.10	.397239	10
51	9.570751	5.25	9.967624	.85	9.603127	6.10	10.396873	9
52	.571066	5.23	.967573	.85	.603493	6.08	.396507	8
53	.571380	5.25	.967522	.85	.603858	6.08	.396142	7
54	.571695	5.23	.967471	.83	.604223	6.08	.395777	6
55	.572009	5.23	.967421	.85	.604588	6.08	.395412	5
56	.572323	5.22	.967370	.85	.604953	6.07	.395047	4
57	.572636	5.23	.967319	.85	.605317	6.08	.394683	3
58	.572950	5.22	.967268	.85	.605682	6.07	.394318	2
59	.573263	5.20	.967217	.85	.606046	6.07	.393954	1
60	9.573575		9.967166		9.606410		10.393590	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.573575	5.22	9.967166	.85	9.606410	6.05	10.393590	60
1	.573888	5.20	.967115	.85	.606773	6.07	.393227	59
2	.574200	5.20	.967064	.85	.607137	6.05	.392863	58
3	.574512	5.20	.967013	.87	.607500	6.05	.392500	57
4	.574824	5.20	.966961	.85	.607863	6.03	.392137	56
5	.575136	5.18	.966910	.85	.608225	6.05	.391775	55
6	.575447	5.18	.966859	.85	.608588	6.03	.391412	54
7	.575758	5.18	.966808	.87	.608950	6.03	.391050	53
8	.576069	5.17	.966756	.85	.609312	6.03	.390688	52
9	.576379	5.17	.966705	.87	.609674	6.03	.390326	51
10	.576689	5.17	.966653	.85	.610036	6.02	.389964	50
11	9.576999	5.17	9.966602	.87	9.610397	6.03	10 389603	49
12	.577309	5.15	.966550	.85	.610759	6.02	.389241	48
13	.577618	5.15	.966499	.87	.611120	6.00	.388880	47
14	577927	5 15	.966447	.87	.611480	6.02	.388520	46
15	.578236	5.15	.966395	.85	.611841	6.00	.388159	45
16	.578545	5.13	.966344	.87	.612201	6.00	.387799	44
17	.578853	5.15	.966292	.87	.612561	6.00	.387439	43
18	.579162	5.13	.966240	.87	.612921	6.00	.387079	42
19	.579470	5.12	.966188	.87	.613281	6.00	.386719	41
20	.579777	5.13	.966136	.85	.613641	5.98	.386359	40
21	9.580085	5.12	9.966085	.87	9.614000	5.98	10.386000	39
22	.580392	5.12	.966033	.87	.614359	5.98	.385641	38
23	.580699	5.10	.965981	.87	.614718	5 98	.385282	37
24	.581005	5.12	.965929	.88	.615077	5.97	.384923	36
25	.581312	5.10	.965876	.87	.615435	5.97	.384565	35
26	.581618	5.10	.965824	.87	.615793	5.97	.384207	34
27	.581924	5.08	.965772	.87	.616151	5.97	.383849	33
28	.582229	5.10	.965720	.87	.616509	5.97	.383491	32
29	.582535	5.08	.965668	.88	.616867	5.95	.383133	31
30	.582840	5.08	.965615	.87	.617224	5 97	.382776	30
31	9.583145	5.07	9 965563	.87	9.617582	5.95	10 382418	29
32	.583449	5.08	.965511	.88	617939	5.93	.382061	28
33	583754	5.07	.965458	.87	.618295	5.95	.381705	27
34	.584058	5.05	.965406	.88	.618652	5.93	.381348	26
35	.584361	5.07	.965353	.87	.619008	5.93	.380992	25
36	.584665	5.05	.965301	.88	.619364	5.93	.380636	24
37	.584968	5.07	.965248	.88	.619720	5.93	.380280	23
38	.585272	5.03	.965195	.87	.620076	5 93	.379924	22
39	.585574	5.05	.965143	.88	.620432	5.92	.379568	21
40	.585877	5.03	.965090	.88	.620787	5.92	.379213	20
41	9.586179	5.05	9.965037	.88	9.621142	5.92	10.378858	19
42	.586482	5.02	.964984	.88	.621497	5.92	.378503	18
43	586783	5.03	.964931	.87	.621852	5.92	.378148	17
44	.587085	5.02	.964879	.88	.622207	5.90	.377793	16
45	.587386	5.03	.964826	.88	.622561	5.90	.377439	15
46	.587688	5.02	.964773	.88	.622915	5.90	.377085	14
47	.587989	5.00	.964720	.90	.623269	5.90	.376731	13
48	.588289	5.02	.964666	.88	.623623	5.88	.376377	12
49	.588590	5.00	.964613	.88	.623976	5.90	.376024	11
50	.588890	5.00	.964560	.88	.624330	5.88	.375670	10
51	9.589190	4.98	9.964507	.88	9.624683	5.88	10.375317	9
52	.589489	5.00	.964454	.90	.625036	5.87	.374964	8
53	.589789	4.98	.964400	.88	.625388	5.88	.374612	7
54	.590088	4.98	.964347	.88	.625741	5.87	.374259	6
55	.590387	4.98	.964294	.90	.626093	5.87	.373907	5
56	.590686	4.97	.964240	.88	.626445	5.87	.373555	4
57	.590984	4.97	.964187	.90	.626797	5.87	.373203	3
58	591282	4.97	.964133	.88	.627149	5.87	.372851	2
59	.591580	4.97	.964080	.90	.627501	5.85	.372499	1
60	9.591878		9.964026		9.627852		10.372148	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.591878	4.97	9.964026	.90	9.627852	5.85	10.372148	60
1	.592176	4.95	.963972	.88	.628203	5.85	.371797	59
2	.592473	4.95	.963919	.90	.628554	5.85	.371446	58
3	.592770	4.95	.963865	.90	.628905	5.83	.371095	57
4	.593067	4.93	.963811	.90	.629255	5.85	.370745	56
5	.593363	4.93	.963757	.88	.629606	5.83	.370394	55
6	.593659	4.93	.963704	.90	.629956	5.83	.370044	54
7	.593955	4.93	.963650	.90	.630306	5.83	.369694	53
8	.594251	4.93	.963596	.90	.630656	5.82	.369344	52
9	.594547	4.92	.963542	.90	.631005	5.83	.368995	51
10	.594842	4.92	.963488	.90	.631355	5.82	.368645	50
11	9.595137	4.92	9.963434	.92	9.631704	5.82	10.368296	49
12	.595432	4.92	.963379	.90	.632053	5.82	.367947	48
13	.595727	4.90	.963325	.90	.632402	5.80	.367598	47
14	.596021	4.90	.963271	.90	.632750	5.82	.367250	46
15	.596315	4.90	.963217	.90	.633099	5.80	.366901	45
16	.596609	4.90	.963163	.92	.633447	5.80	.366553	44
17	.596903	4.88	.963108	.90	.633795	5.80	.366205	43
18	.597196	4.90	.963054	.92	.634143	5.78	.365857	42
19	.597490	4.88	.962999	.90	.634490	5.80	.365510	41
20	.597783	4.87	.962945	.92	.634838	5.78	.365162	40
21	9.598075	4.88	9.962890	.90	9.635185	5.78	10.364815	39
22	.598368	4.87	.962836	.92	.635532	5.78	.364468	38
23	.598660	4.87	.962781	.90	.635879	5.78	.364121	37
24	.598952	4.87	.962727	.92	.636226	5.77	.363774	36
25	.599244	4.87	.962672	.92	.636572	5.78	.363428	35
26	.599536	4.85	.962617	.92	.636919	5.77	.363081	34
27	.599827	4.85	.962562	.90	.637265	5.77	.362735	33
28	.600118	4.85	.962508	.92	.637611	5.75	.362389	32
29	.600409	4.85	.962453	.92	.637956	5.77	.362044	31
30	.600700	4.83	.962398	.92	.638302	5.75	.361698	30
31	9.600990	4.83	9.962343	.92	9.638647	5.75	10.361353	29
32	.601280	4.83	.962288	.92	.638992	5.75	.361008	28
33	.601570	4.83	.962233	.92	.639337	5.75	.360663	27
34	.601860	4.83	.962178	.92	.639682	5.75	.360318	26
35	.602150	4.82	.962123	.93	.640027	5.73	.359973	25
36	.602439	4.82	.962067	.92	.640371	5.75	.359629	24
37	.602728	4.82	.962012	.92	.640716	5.73	.359284	23
38	.603017	4.80	.961957	.92	.641060	5.73	.358940	22
39	.603305	4.82	.961902	.93	.641404	5.72	.358596	21
40	.603594	4.80	.961846	.92	.641747	5.73	.358253	20
41	9.603882	4.80	9.961791	.93	9.642091	5.72	10.357909	19
42	.604170	4.78	.961735	.92	.642434	5.72	.357566	18
43	.604457	4.80	.961680	.93	.642777	5.72	.357223	17
44	.604745	4.78	.961624	.92	.643120	5.72	.356880	16
45	.605032	4.78	.961569	.93	.643463	5.72	.356537	15
46	.605319	4.78	.961513	.92	.643806	5.70	.356194	14
47	.605606	4.77	.961458	.93	.644148	5.70	.355852	13
48	.605892	4.78	.961402	.93	.644490	5.70	.355510	12
49	.606179	4.77	.961346	.93	.644832	5.70	.355168	11
50	.606465	4.77	.961290	.92	.645174	5.70	.354826	10
51	9.606751	4.75	9.961235	.93	9.645516	5.68	10.354484	9
52	.607036	4.77	.961179	.93	.645857	5.70	.354143	8
53	.607322	4.75	.961123	.93	.646199	5.68	.353801	7
54	.607607	4.75	.961067	.93	.646540	5.68	.353460	6
55	.607892	4.75	.961011	.93	.646881	5.68	.353119	5
56	.608177	4.73	.960955	.93	.647222	5.67	.352778	4
57	.608461	4.73	.960899	.93	.647562	5.68	.352438	3
58	.608745	4.73	.960843	.95	.647903	5.67	.352097	2
59	.609029	4.73	.960786	.93	.648243	5.67	.351757	1
60	9.609313		9.960730		9.648583		10.351417	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.609313	4.73	9.960730	.93	9.648583	5.67	10.351417	60
1	.609597	4.72	.960674	.93	.648923	5.67	.351077	59
2	.609880	4.73	.960618	.95	.649263	5.65	.350737	58
3	.610164	4.72	.960561	.93	.649602	5.67	.350398	57
4	.610447	4.70	.960505	.95	.649942	5.65	.350058	56
5	.610729	4.72	.960448	.93	.650281	5.65	.349719	55
6	.611012	4.70	.960392	.95	.650620	5.65	.349380	54
7	.611294	4.70	.960335	.93	.650959	5.63	.349041	53
8	.611576	4.70	.960279	.95	.651297	5.65	.348703	52
9	.611858	4.70	.960222	.95	.651636	5.63	.348364	51
10	.612140	4.68	.960165	.93	.651974	5.63	.348026	50
11	9.612421	4.68	9.960109	.95	9.652312	5.63	10.347688	49
12	.612702	4.68	.960052	.95	.652650	5.63	.347350	48
13	.612983	4.68	.959995	.95	.652988	5.63	.347012	47
14	.613264	4.68	.959938	.93	.653326	5.62	.346674	46
15	.613545	4.67	.959882	.95	.653663	5.62	.346337	45
16	.613825	4.67	.959825	.95	.654000	5.62	.346000	44
17	.614105	4.67	.959768	.95	.654337	5.62	.345663	43
18	.614385	4.67	.959711	.95	.654674	5.62	.345326	42
19	.614665	4.65	.959654	.97	.655011	5.62	.344989	41
20	.614944	4.65	.959596	.95	.655348	5.60	.344652	40
21	9.615223	4.65	9.959539	.95	9.655684	5.60	10.344316	39
22	.615502	4.65	.959482	.95	.656020	5.60	.343980	38
23	.615781	4.65	.959425	.95	.656356	5.60	.343644	37
24	.616060	4.63	.959368	.97	.656692	5.60	.343308	36
25	.616338	4.63	.959310	.95	.657028	5.60	.342972	35
26	.616616	4.63	.959253	.97	.657364	5.58	.342636	34
27	.616894	4.63	.959195	.95	.657699	5.58	.342301	33
28	.617172	4.63	.959138	.97	.658034	5.58	.341966	32
29	.617450	4.62	.959080	.95	.658369	5.58	.341631	31
30	.617727	4.62	.959023	.97	.658704	5.58	.341296	30
31	9.618004	4.62	9.958965	.95	9.659039	5.57	10.340961	29
32	.618281	4.62	.958908	.97	.659373	5.58	.340627	28
33	.618558	4.60	.958850	.97	.659708	5.57	.340292	27
34	.618834	4.60	.958792	.97	.660042	5.57	.339958	26
35	.619110	4.60	.958734	.95	.660376	5.57	.339624	25
36	.619386	4.60	.958677	.97	.660710	5.55	.339290	24
37	.619662	4.60	.958619	.97	.661043	5.57	.338957	23
38	.619938	4.58	.958561	.97	.661377	5.55	.338623	22
39	.620213	4.58	.958503	.97	.661710	5.55	.338290	21
40	.620488	4.58	.958445	.97	.662043	5.55	.337957	20
41	9.620763	4.58	9.958387	.97	9.662376	5.55	10.337624	19
42	.621038	4.58	.958329	.97	.662709	5.55	.337291	18
43	.621313	4.57	.958271	.97	.663042	5.55	.336958	17
44	.621587	4.57	.958213	.98	.663375	5.53	.336625	16
45	.621861	4.57	.958154	.97	.663707	5.53	.336293	15
46	.622135	4.57	.958096	.97	.664039	5.53	.335961	14
47	.622409	4.55	.958038	.98	.664371	5.53	.335629	13
48	.622682	4.57	.957979	.97	.664703	5.53	.335297	12
49	.622956	4.55	.957921	.97	.665035	5.52	.334965	11
50	.623229	4.55	.957863	.98	.665366	5.53	.334634	10
51	9.623502	4.53	9.957804	.97	9.665698	5.52	10.334302	9
52	.623774	4.55	.957746	.98	.666029	5.52	.333971	8
53	.624047	4.53	.957687	.98	.666360	5.52	.333640	7
54	.624319	4.53	.957628	.97	.666691	5.50	.333309	6
55	.624591	4.53	.957570	.98	.667021	5.52	.332979	5
56	.624863	4.53	.957511	.98	.667352	5.50	.332648	4
57	.625135	4.52	.957452	.98	.667682	5.52	.332318	3
58	.625406	4.52	.957393	.97	.668013	5.50	.331987	2
59	.625677	4.52	.957335	.98	.668343	5.50	.331657	1
60	9.625948		9.957276		9.668673		10.331327	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.625948	4.52	9.957276	.98	9.668673	5.48	10.331327	60
1	.626219	4.52	.957217	.98	.669002	5.50	.330998	59
2	.626490	4.50	.957158	.98	.669332	5.48	.330668	58
3	.626760	4.50	.957099	.98	.669661	5.50	.330339	57
4	.627030	4.50	.957040	.98	.669991	5.48	.330009	56
5	.627300	4.50	.956981	1.00	.670320	5.48	.329680	55
6	.627570	4.50	.956921	.98	.670649	5.47	.329351	54
7	.627840	4.48	.956862	.98	.670977	5.48	.329023	53
8	.628109	4.48	.956803	.98	.671306	5.48	.328694	52
9	.628378	4.48	.956744	1.00	.671635	5.47	.328365	51
10	.628647	4.48	.956684	.98	.671963	5.47	.328037	50
11	9.628916	4.48	9.956625	.98	9.672291	5.47	10.327709	49
12	.629185	4.47	.956566	1.00	.672619	5.47	.327381	48
13	.629453	4.47	.956506	.98	.672947	5.45	.327053	47
14	.629721	4.47	.956447	1.00	.673274	5.47	.326726	46
15	.629989	4.47	.956387	1.00	.673602	5.45	.326398	45
16	.630257	4.45	.956327	.98	.673929	5.47	.326071	44
17	.630524	4.47	.956268	1.00	.674257	5.45	.325743	43
18	.630792	4.45	.956208	1.00	.674584	5.45	.325416	42
19	.631059	4.45	.956148	.98	.674911	5.43	.325089	41
20	.631326	4.45	.956089	1.00	.675237	5.45	.324763	40
21	9.631593	4.43	9.956029	1.00	9.675564	5 43	10.324436	39
22	631859	4.43	.955969	1.00	.675890	5.45	.324110	38
23	.632125	4.45	.955909	1.00	.676217	5.43	.323783	37
24	.632392	4.43	.955849	1.00	.676543	5.43	.323457	36
25	.632658	4.42	.955789	1.00	.676869	5.42	.323131	35
26	.632923	4.43	.955729	1.00	.677194	5.43	.322806	34
27	.633189	4.42	.955669	1.00	.677520	5.43	.322480	33
28	.633454	4.42	.955609	.98	.677846	5.42	.322154	32
29	.633719	4.42	.955548	1 00	.678171	5.42	.321829	31
30	.633984	4.42	.955488	1.00	.678496	5.42	.321504	30
31	9.634249	4.42	9 955428	1.00	9.678821	5.42	10.321179	29
32	.634514	4.40	.955368	1.02	.679146	5 42	.320854	28
33	.634778	4.40	.955307	1.00	.679471	5.40	.320529	27
34	.635042	4.40	.955247	1.02	.679795	5.42	.320205	26
35	.635306	4.40	.955186	1.00	.680120	5.40	.319880	25
36	.635570	4.40	.955126	1.02	.680444	5.40	.319556	24
37	.635834	4.38	.955065	1.00	.680768	5.40	.319232	23
38	.636097	4 38	.955005	1.02	.681092	5.40	.318908	22
39	636360	4.38	.954944	1.02	.681416	5.40	.318584	21
40	.636623	4.38	.954883	1.00	.681740	5.38	.318260	20
41	9.636886	4.37	9 954823	1 02	9.682063	5.40	10 317937	19
42	637148	4.38	.954762	1.02	.682387	5.38	.317613	18
43	.637411	4.37	.954701	1.02	.682710	5.38	.317290	17
44	.637673	4.37	.954640	1.02	.683033	5 38	.316967	16
45	.637935	4.37	.954579	1.02	.683356	5.38	.316644	15
46	.638197	4.35	.954518	1.02	.683679	5.37	.316321	14
47	.638458	4.37	.954457	1.02	.684001	5.38	.315999	13
48	.638720	4.35	.954396	1 02	.684324	5.37	.315676	12
49	.638981	4.35	.954335	1.02	.684646	5.37	.315354	11
50	.639242	4.35	.954274	1.02	.684968	5.37	.315032	10
51	9.639503	4.35	9.954213	1.02	9.685290	5.37	10 314710	9
52	.639764	4.33	.954152	1.03	.685612	5.37	.314388	8
53	.640024	4.33	.954090	1.02	.685934	5.35	314066	7
54	.640284	4.33	.954029	1.02	686255	5.37	313745	6
55	.640544	4.33	.953968	1 03	.686577	5 35	.313423	5
56	.640804	4.33	.953906	1.02	.686898	5.35	.313102	4
57	.641064	4.33	.953845	1.03	.687219	5 35	.312781	3
58	.641324	4.32	.953783	1.02	.687540	5.35	.312460	2
59	.641583	4.32	.953722	1.03	.687861	5.35	.312139	1
60	9.641842		9.953660		9.688182		10.311818	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.641842	4.32	9.953660	1.02	9.688182	5.33	10.311818	60
1	.642101	4.32	.953599	1.03	.688502	5.32	.311498	59
2	.642360	4.30	.953537	1.03	.688823	5.33	.311177	58
3	.642618	4.32	.953475	1.03	.689143	5.33	.310857	57
4	.642877	4.30	.953413	1.02	.689463	5.33	.310537	56
5	.643135	4.30	.953352	1.03	.689783	5.33	.310217	55
6	.643393	4.28	.953290	1.03	.690103	5.33	.309897	54
7	.643650	4.30	.953228	1.03	.690423	5.32	.309577	53
8	.643908	4.28	.953166	1.03	.690742	5.33	.309258	52
9	.644165	4.30	.953104	1.03	.691062	5.32	.308938	51
10	.644423	4.28	.953042	1.03	.691381	5.32	.308619	50
11	9.644680	4.27	9.952980	1.03	9.691700	5.32	10.308300	49
12	.644936	4.28	.952918	1.05	.692019	5.32	.307981	48
13	.645193	4.28	.952855	1.03	.692338	5.30	.307662	47
14	.645450	4.27	.952793	1.03	.692656	5.32	.307344	46
15	.645706	4.27	.952731	1.03	.692975	5.30	.307025	45
16	.645962	4.27	.952669	1.05	.693293	5.32	.306707	44
17	.646218	4.27	.952606	1.03	.693612	5.30	.306388	43
18	.646474	4.25	.952544	1.05	.693930	5.30	.306070	42
19	.646729	4.25	.952481	1.03	.694248	5.30	.305752	41
20	.646984	4.27	.952419	1.05	.694566	5.28	.305434	40
21	9.647240	4.23	9.952356	1.03	9.694883	5.30	10.305117	39
22	.647494	4.25	.952294	1.05	.695201	5.28	.304799	38
23	.647749	4.25	.952231	1.05	.695518	5.30	.304482	37
24	.648004	4.23	.952168	1.03	.695836	5.28	.304164	36
25	.648258	4.23	.952106	1.05	.696153	5.28	.303847	35
26	.648512	4.23	.952043	1.05	.696470	5.28	.303530	34
27	.648766	4.23	.951980	1.05	.696787	5.27	.303213	33
28	.649020	4.23	.951917	1.05	.697103	5.28	.302897	32
29	.649274	4.22	.951854	1.05	.697420	5.27	.302580	31
30	.649527	4.23	.951791	1.05	.697736	5.28	.302264	30
31	9.649781	4.22	9.951728	1.05	9.698053	5.27	10.301947	29
32	.650034	4.22	.951665	1.05	.698369	5.27	.301631	28
33	.650287	4.20	.951602	1.05	.698685	5.27	.301315	27
34	.650539	4.22	.951539	1.05	.699001	5.25	.300999	26
35	.650792	4.20	.951476	1.07	.699316	5.27	.300684	25
36	.651044	4.22	.951412	1.05	.699632	5.25	.300368	24
37	.651297	4.20	.951349	1.05	.699947	5.27	.300053	23
38	.651549	4.18	.951286	1.07	.700263	5.25	.299737	22
39	.651800	4.20	.951222	1.05	.700578	5.25	.299422	21
40	.652052	4.20	.951159	1.05	.700893	5.25	.299107	20
41	9.652304	4.18	9.951096	1.07	9.701208	5.25	10.298792	19
42	.652555	4.18	.951032	1.07	.701523	5.23	.298477	18
43	.652806	4.18	.950968	1.05	.701837	5.25	.298163	17
44	.653057	4.18	.950905	1.07	.702152	5.23	.297848	16
45	653308	4.17	.950841	1.05	.702466	5.25	.297534	15
46	.653558	4.17	.950778	1.07	.702781	5.23	.297219	14
47	.653808	4.18	.950714	1.07	.703095	5.23	.296905	13
48	.654059	4.17	.950650	1.07	.703409	5.22	.296591	12
49	.654309	4.15	.950586	1.07	.703722	5.23	.296278	11
50	.654558	4.17	.950522	1.07	.704036	5.23	.295964	10
51	9.654808	4.17	9.950458	1.07	9.704350	5.22	10.295650	9
52	.655058	4.15	.950394	1.07	.704663	5.22	.295337	8
53	.655307	4.15	.950330	1.07	.704976	5.23	.295024	7
54	.655556	4.15	.950266	1.07	.705290	5.22	.294710	6
55	.655805	4.15	.950202	1.07	.705603	5.22	.294397	5
56	.656054	4.13	.950138	1.07	.705916	5.20	.294084	4
57	656302	4.15	.950074	1.07	.706228	5.22	.293772	3
58	.656551	4.13	.950010	1.08	.706541	5.22	.293459	2
59	.656799	4.13	.949945	1.07	.706854	5.20	.293146	1
60	9.657047		9.949881		9.707166		10.292834	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.657047	4.13	9.949881	1.08	9.707166	5.20	10.292834	60
1	.657295	4.12	.949816	1.07	.707478	5.20	.292522	59
2	.657542	4.13	.949752	1.07	.707790	5.20	.292210	58
3	.657790	4.12	.949688	1.08	.708102	5.20	.291898	57
4	.658037	4.12	.949623	1.08	.708414	5.20	.291586	56
5	.658284	4.12	.949558	1.07	.708726	5.18	.291274	55
6	.658531	4.12	.949494	1.08	.709037	5.20	.290963	54
7	.658778	4.12	.949429	1.08	.709349	5.18	.290651	53
8	.659025	4.10	.949364	1.07	.709660	5.18	.290340	52
9	.659271	4.10	.949300	1.08	.709971	5.18	.290029	51
10	.659517	4.10	.949235	1.08	.710282	5.18	.289718	50
11	9.659763	4.10	9.949170	1.08	9.710593	5.18	10.289407	49
12	.660009	4.10	.949105	1.08	.710904	5.18	.289096	48
13	.660255	4.10	.949040	1.08	.711215	5.17	.288785	47
14	.660501	4.08	.948975	1.08	.711525	5.18	.288475	46
15	660746	4.08	.948910	1.08	.711836	5.17	.288164	45
16	.660991	4.08	.948845	1.08	.712146	5.17	.287854	44
17	.661236	4.08	.948780	1.08	.712456	5.17	.287544	43
18	.661481	4.08	.948715	1.08	.712766	5.17	.287234	42
19	.661726	4.07	.948650	1.10	.713076	5.17	.286924	41
20	.661970	4.07	.948584	1.08	.713386	5.17	.286614	40
21	9.662214	4.08	9.948519	1.08	9.713696	5.15	10.286304	39
22	.662459	4.07	.948454	1.10	.714005	5.15	.285995	38
23	.662703	4.05	.948388	1.08	.714314	5.17	.285686	37
24	.662946	4.07	.948323	1.10	.714624	5.15	.285376	36
25	.663190	4.05	.948257	1.08	.714933	5.15	.285067	35
26	.663433	4.07	.948192	1.10	.715242	5.15	.284758	34
27	.663677	4.05	.948126	1.10	.715551	5.15	.284449	33
28	.663920	4.05	.948060	1.08	.715860	5.13	.284140	32
29	.664163	4.05	.947995	1.10	.716168	5.15	.283832	31
30	.664406	4.03	.947929	1.10	.716477	5.13	.283523	30
31	9.664648	4.05	9.947863	1 10	9.716785	5 13	10.283215	29
32	.664891	4.03	.947797	1.10	.717093	5.13	.282907	28
33	.665133	4.03	.947731	1.10	.717401	5.13	.282599	27
34	.665375	4.03	.947665	1.08	.717709	5.13	.282291	26
35	.665617	4.03	.947600	1.12	.718017	5.13	281983	25
36	.665859	4.02	.947533	1.10	.718325	5.13	.281675	24
37	.666100	4.03	.947467	1.10	.718633	5.12	.281367	23
38	.666342	4.02	.947401	1.10	.718940	5.13	.281060	22
39	.666583	4.02	.947335	1.10	.719248	5.12	.280752	21
40	.666824	4.02	.947269	1.10	.719555	5.12	.280445	20
41	9.667065	4.00	9.947203	1.12	9.719862	5.12	10.280138	19
42	.667305	4.02	.947136	1.10	.720169	5.12	.279831	18
43	.667546	4.00	.947070	1.10	.720476	5.12	.279524	17
44	.667786	4.02	.947004	1.12	.720783	5.10	.279217	16
45	.668027	4.00	.946937	1.10	.721089	5.12	.278911	15
46	.668267	3.98	.946871	1.12	.721396	5.10	.278604	14
47	.668506	4.00	946804	1.10	.721702	5.12	.278298	13
48	.668746	4.00	.946738	1.12	.722009	5.10	.277991	12
49	.668986	3.98	.946671	1.12	.722315	5.10	277685	11
50	.669225	3.98	.946604	1.10	.722621	5.10	.277379	10
51	9.669464	3.98	9.946538	1.12	9.722927	5.08	10.277073	9
52	669703	3.98	.946471	1.12	723232	5.10	.276768	8
53	.669942	3.98	.946404	1.12	723538	5.10	276462	7
54	670181	3.97	946337	1.12	.723844	5.08	.276156	6
55	670419	3.98	.946270	1.12	.724149	5.08	.275851	5
56	.670658	3.97	.946203	1.12	.724454	5.10	.275546	4
57	670896	3.97	.946136	1.12	724760	5.08	275240	3
58	.671134	3.97	.946069	1.12	725065	5.08	274935	2
59	.671372	3.95	.946002	1.12	725370	5.07	274630	1
60	9.671609		9.945935		9.725674		10.274326	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.671609	3.97	9.945935	1.12	9.725674	5.08	10.274326	60
1	.671847	3.95	.945868	1.13	.725979	5.08	.274021	59
2	.672084	3.95	.945800	1.12	.726284	5.07	.273716	58
3	.672321	3.95	.945733	1.12	.726588	5.07	.273412	57
4	.672558	3.95	.945666	1.13	.726892	5.05	.273108	56
5	.672795	3.95	.945598	1.12	.727197	5.07	.272803	55
6	.673032	3.93	.945531	1.12	.727501	5.07	.272499	54
7	.673268	3.95	.945464	1.13	.727805	5.07	.272195	53
8	.673505	3.93	.945396	1.13	.728109	5.05	.271891	52
9	.673741	3.93	.945328	1.12	.728412	5.07	.271588	51
10	.673977	3.93	.945261	1.13	.728716	5.07	.271284	50
11	9.674213	3.92	9.945193	1.13	9.729020	5.05	10.270980	49
12	.674448	3.93	.945125	1.12	.729323	5.05	.270677	48
13	.674684	3.92	.945058	1.13	.729626	5.05	.270374	47
14	.674919	3.93	.944990	1.13	.729929	5.07	.270071	46
15	.675155	3.92	.944922	1.13	.730233	5.03	.269767	45
16	.675390	3.90	.944854	1.13	.730535	5.05	.269465	44
17	.675624	3.92	.944786	1.13	.730838	5.05	.269162	43
18	.675859	3.92	.944718	1.13	.731141	5.05	.268859	42
19	.676094	3.90	.944650	1.13	.731444	5.03	.268556	41
20	.676328	3.90	.944582	1.13	.731746	5.03	.268254	40
21	9.676562	3.90	9.944514	1.13	9.732048	5.05	10.267952	39
22	.676796	3.90	.944446	1.15	.732351	5.03	.267649	38
23	.677030	3.90	.944377	1.13	.732653	5.03	.267347	37
24	.677264	3.90	.944309	1.13	.732955	5.03	.267045	36
25	.677498	3.88	.944241	1.15	.733257	5.02	.266743	35
26	.677731	3.88	.944172	1.13	.733558	5.03	.266442	34
27	.677964	3.88	.944104	1.13	.733860	5.03	.266140	33
28	.678197	3.88	.944036	1.15	.734162	5.02	.265838	32
29	.678430	3.88	.943967	1.13	.734463	5.02	.265537	31
30	.678663	3.87	.943899	1.15	.734764	5.03	.265236	30
31	9.678895	3.88	9.943830	1.15	9.735066	5.02	10.264934	29
32	.679128	3.87	.943761	1.13	.735367	5.02	.264633	28
33	.679360	3.87	.943693	1.15	.735668	5.02	.264332	27
34	.679592	3.87	.943624	1.15	.735969	5.00	.264031	26
35	.679824	3.87	.943555	1.15	.736269	5.02	.263731	25
36	.680056	3.87	.943486	1.15	.736570	5.00	.263430	24
37	.680288	3.85	.943417	1.15	.736870	5.02	.263130	23
38	.680519	3.85	.943348	1.15	.737171	5.00	.262829	22
39	.680750	3.87	.943279	1.15	.737471	5.00	.262529	21
40	.680982	3.85	.943210	1.15	.737771	5.00	.262229	20
41	9.681213	3.83	9.943141	1.15	9.738071	5.00	10.261929	19
42	.681443	3.85	.943072	1.15	.738371	5.00	.261629	18
43	.681674	3.85	.943003	1.15	.738671	5.00	.261329	17
44	.681905	3.83	.942934	1.17	.738971	5.00	.261029	16
45	.682135	3.83	.942864	1.15	.739271	4.98	.260729	15
46	.682365	3.83	.942795	1.15	.739570	5.00	.260430	14
47	.682595	3.83	.942726	1.17	.739870	4.98	.260130	13
48	.682825	3.83	.942656	1.15	.740169	4.98	.259831	12
49	.683055	3.82	.942587	1.17	.740468	4.98	.259532	11
50	.683284	3.83	.942517	1.15	.740767	4.98	.259233	10
51	9.683514	3.82	9.942448	1.17	9.741066	4.98	10.258934	9
52	.683743	3.82	.942378	1.17	.741365	4.98	.258635	8
53	.683972	3.82	.942308	1.15	.741664	4.97	.258336	7
54	.684201	3.82	.942239	1.17	.741962	4.98	.258038	6
55	.684430	3.80	.942169	1.17	.742261	4.97	.257739	5
56	.684658	3.82	.942099	1.17	.742559	4.98	.257441	4
57	.684887	3.80	.942029	1.17	.742858	4.97	.257142	3
58	.685115	3.80	.941959	1.17	.743156	4.97	.256844	2
59	.685343	3.80	.941889	1.17	.743454	4.97	.256546	1
60	9.685571		9.941819		9.743752		10.256248	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.685571	3.80	9.941819	1.17	9.743752	4.97	10.256248	60
1	.685799	3.80	.941749	1.17	.744050	4.97	.255950	59
2	.686027	3.78	.941679	1.17	.744348	4.95	.255652	58
3	.686254	3.80	.941609	1.17	.744645	4.97	.255355	57
4	.686482	3.78	.941539	1.17	.744943	4.95	.255057	56
5	.686709	3.78	.941469	1.18	.745240	4.97	.254760	55
6	.686936	3.78	.941398	1.17	.745538	4.95	.254462	54
7	.687163	3.77	.941328	1.17	.745835	4.95	.254165	53
8	.687389	3.78	.941258	1.18	.746132	4.95	.253868	52
9	.687616	3.78	.941187	1.17	.746429	4.95	.253571	51
10	.687843	3.77	.941117	1.18	.746726	4.95	.253274	50
11	9.688069	3.77	9.941046	1.18	9.747023	4.93	10.252977	49
12	.688295	3.77	.940975	1.17	.747319	4.95	.252681	48
13	.688521	3.77	.940905	1.18	.747616	4.95	.252384	47
14	.688747	3.75	.940834	1.18	.747913	4.93	.252087	46
15	.688972	3.77	.940763	1.17	.748209	4.93	.251791	45
16	.689198	3.75	.940693	1.18	.748505	4.93	.251495	44
17	.689423	3.75	.940622	1.18	.748801	4.93	.251199	43
18	.689648	3.75	.940551	1.18	.749097	4.93	.250903	42
19	.689873	3.75	.940480	1.18	.749393	4.93	.250607	41
20	.690098	3.75	.940409	1.18	.749689	4.93	.250311	40
21	9.690323	3.75	9.940338	1.18	9.749985	4.93	10.250015	39
22	.690548	3.73	.940267	1.18	.750281	4.92	.249719	38
23	.690772	3.73	.940196	1.18	.750576	4.93	.249424	37
24	.690996	3.73	.940125	1.18	.750872	4.92	.249128	36
25	.691220	3.73	.940054	1.20	.751167	4.92	.248833	35
26	.691444	3.73	.939982	1.18	.751462	4.92	.248538	34
27	.691668	3.73	.939911	1.18	.751757	4.92	.248243	33
28	.691892	3.72	.939840	1.20	.752052	4.92	.247948	32
29	.692115	3.73	.939768	1.18	.752347	4.92	.247653	31
30	.692339	3.72	.939697	1.20	.752642	4.92	.247358	30
31	9.692562	3.72	9.939625	1.18	9.752937	4.90	10.247063	29
32	.692785	3.72	.939554	1.20	.753231	4 92	.246769	28
33	.693008	3.72	.939482	1 20	.753526	4.90	.246474	27
34	.693231	3.70	.939410	1.18	.753820	4.92	.246180	26
35	.693453	3.72	.939339	1.20	.754115	4.90	.245885	25
36	.693676	3.70	.939267	1.20	.754409	4.90	.245591	24
37	.693898	3.70	.939195	1.20	.754703	4.90	245297	23
38	.694120	3.70	.939123	1.18	.754997	4.90	.245003	22
39	.694342	3.70	.939052	1.20	.755291	4.90	.244709	21
40	.694564	3.70	.938980	1.20	.755585	4.88	.244415	20
41	9.694786	3.68	9.938908	1.20	9.755878	4.90	10.244122	19
42	.695007	3.70	.938836	1.22	.756172	4.88	.243828	18
43	.695229	3.68	.938763	1.20	.756465	4.90	.243535	17
44	.695450	3 68	.938691	1.20	.756759	4.88	.243241	16
45	.695671	3.68	.938619	1.20	.757052	4.88	.242948	15
46	.695892	3.68	.938547	1.20	.757345	4.88	.242655	14
47	.696113	3.68	.938475	1.22	.757638	4.88	.242362	13
48	.696334	3.67	.938402	1.20	.757931	4.88	.242069	12
49	.696554	3.68	.938330	1.20	.758224	4.88	.241776	11
50	.696775	3.67	.938258	1.22	.758517	4.88	.241483	10
51	9.696995	3.67	9.938185	1.20	9.758810	4.87	10.241190	9
52	.697215	3.67	.938113	1.22	.759102	4.88	.240898	8
53	.697435	3.65	.938040	1.22	.759395	4.87	.240605	7
54	.697654	3.67	.937967	1.20	.759687	4.87	240313	6
55	.697874	3.67	.937895	1.22	.759979	4.88	.240021	5
56	.698094	3.65	.937822	1.22	.760272	4.87	.239728	4
57	.698313	3.65	.937749	1.22	.760564	4.87	.239436	3
58	.698532	3.65	.937676	1.20	.760856	4.87	.239144	2
59	.698751	3.65	.937604	1.22	.761148	4.85	.238852	1
60	9.698970		9.937531		9.761439		10.238561	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.698970	3.65	9.937531	1.22	9.761439	4.87	10.238561	60
1	.699189	3.63	.937458	1.22	.761731	4.87	.238269	59
2	.699407	3.65	.937385	1.22	.762023	4.85	.237977	58
3	.699626	3.63	.937312	1.23	.762314	4.87	.237686	57
4	.699844	3.63	.937238	1.22	.762606	4.85	.237394	56
5	.700062	3.63	.937165	1.22	.762897	4.85	.237103	55
6	.700280	3.63	.937092	1.22	.763188	4.85	.236812	54
7	.700498	3.63	.937019	1.22	.763479	4.85	.236521	53
8	.700716	3.62	.936946	1.23	.763770	4.85	.236230	52
9	.700933	3.63	.936872	1.22	.764061	4.85	.235939	51
10	.701151	3.62	.936799	1.23	.764352	4.85	.235648	50
11	9.701368	3.62	9.936725	1.22	9.764643	4.83	10.235357	49
12	.701585	3.62	.936652	1.23	.764933	4.85	.235067	48
13	.701802	3.62	.936578	1.22	.765224	4.83	.234776	47
14	.702019	3.62	.936505	1.23	.765514	4.85	.234486	46
15	.702236	3.60	.936431	1.23	.765805	4.83	.234195	45
16	.702452	3.62	.936357	1.22	.766095	4.83	.233905	44
17	.702669	3.60	.936284	1.23	.766385	4.83	.233615	43
18	.702885	3.60	.936210	1.23	.766675	4.83	.233325	42
19	.703101	3.60	.936136	1.23	.766965	4.83	.233035	41
20	.703317	3.60	.936062	1.23	.767255	4.83	.232745	40
21	9.703533	3.60	9.935988	1.23	9.767545	4.82	10.232455	39
22	.703749	3.58	.935914	1.23	.767834	4.83	.232166	38
23	.703964	3.58	.935840	1.23	.768124	4.83	.231876	37
24	.704179	3.60	.935766	1.23	.768414	4.82	.231586	36
25	.704395	3.58	.935692	1.23	.768703	4.82	.231297	35
26	.704610	3.58	.935618	1.25	.768992	4.82	.231008	34
27	.704825	3.58	.935543	1.23	.769281	4.83	.230719	33
28	.705040	3.57	.935469	1.23	.769571	4.82	.230429	32
29	.705254	3.58	.935395	1.25	.769860	4.80	.230140	31
30	.705469	3.57	.935320	1.23	.770148	4.82	.229852	30
31	9.705683	3.58	9.935246	1.25	9.770437	4.82	10.229563	29
32	.705898	3.57	.935171	1.23	.770726	4.82	.229274	28
33	.706112	3.57	.935097	1.25	.771015	4.80	.228985	27
34	.706326	3.55	.935022	1.23	.771303	4.82	.228697	26
35	.706539	3.57	.934948	1.25	.771592	4.80	.228408	25
36	.706753	3.57	.934873	1.25	.771880	4.80	.228120	24
37	.706967	3.55	.934798	1.25	.772168	4.82	.227832	23
38	.707180	3.55	.934723	1.23	.772457	4.80	.227543	22
39	.707393	3.55	.934649	1.25	.772745	4.80	.227255	21
40	.707606	3.55	.934574	1.25	.773033	4.80	.226967	20
41	9.707819	3.55	9.934499	1.25	9.773321	4.78	10.226679	19
42	.708032	3.55	.934424	1.25	.773608	4.80	.226392	18
43	.708245	3.55	.934349	1.25	.773896	4.80	.226104	17
44	.708458	3.53	.934274	1.25	.774184	4.78	.225816	16
45	.708670	3.53	.934199	1.27	.774471	4.80	.225529	15
46	.708882	3.53	.934123	1.25	.774759	4.78	.225241	14
47	.709094	3.53	.934048	1.25	.775046	4.78	.224954	13
48	.709306	3.53	.933973	1.25	.775333	4.80	.224667	12
49	.709518	3.53	.933898	1.27	.775621	4.78	.224379	11
50	.709730	3.52	.933822	1.25	.775908	4.78	.224092	10
51	9.709941	3.53	9.933747	1.27	9.776195	4.78	10.223805	9
52	.710153	3.52	.933671	1.25	.776482	4.77	.223518	8
53	.710364	3.52	.933596	1.27	.776768	4.78	.223232	7
54	.710575	3.52	.933520	1.25	.777055	4.78	.222945	6
55	.710786	3.52	.933445	1.27	.777342	4.77	.222658	5
56	.710997	3.52	.933369	1.27	.777628	4.78	.222372	4
57	.711208	3.52	.933293	1.27	.777915	4.77	.222085	3
58	.711419	3.50	.933217	1.27	.778201	4.78	.221799	2
59	.711629	3.50	.933141	1.25	.778488	4.77	.221512	1
60	9.711839		9.933066		9.778774		10.221226	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.711839	3.52	9.933066	1.27	9.778774	4.77	10.221226	60
1	.712050	3.50	.932990	1.27	.779060	4.77	.220940	59
2	.712260	3.48	.932914	1.27	.779346	4.77	.220654	58
3	.712469	3.50	.932838	1.27	.779632	4.77	.220368	57
4	.712679	3.50	.932762	1.28	.779918	4.75	.220082	56
5	.712889	3.48	.932685	1.27	.780203	4.77	.219797	55
6	.713098	3.50	.932609	1.27	.780489	4.77	.219511	54
7	.713308	3.48	.932533	1.27	.780775	4.75	.219225	53
8	.713517	3.48	.932457	1.28	.781060	4.77	.218940	52
9	.713726	3.48	.932380	1.27	.781346	4.75	.218654	51
10	.713935	3.48	.932304	1.27	.781631	4.75	.218369	50
11	9.714144	3.47	9.932228	1.28	9.781916	4.75	10.218084	49
12	.714352	3.48	.932151	1.27	.782201	4.75	.217799	48
13	.714561	3.47	.932075	1.28	.782486	4.75	.217514	47
14	.714769	3.48	.931998	1.28	.782771	4.75	.217229	46
15	.714978	3.47	.931921	1.27	.783056	4.75	.216944	45
16	.715186	3.47	.931845	1.28	.783341	4.75	.216659	44
17	.715394	3.47	.931768	1.28	.783626	4.73	.216374	43
18	.715602	3.45	.931691	1.28	.783910	4.75	.216090	42
19	.715809	3.47	.931614	1.28	.784195	4.73	.215805	41
20	.716017	3.45	.931537	1.28	.784479	4.75	.215521	40
21	9.716224	3.47	9.931460	1.28	9.784764	4.73	10.215236	39
22	.716432	3.45	.931383	1.28	.785048	4.73	.214952	38
23	.716639	3.45	.931306	1.28	.785332	4.73	.214668	37
24	.716846	3.45	.931229	1.28	.785616	4.73	.214384	36
25	.717053	3.43	.931152	1.28	.785900	4.73	.214100	35
26	.717259	3.45	.931075	1.28	.786184	4.73	.213816	34
27	.717466	3.45	.930998	1.28	.786468	4.73	.213532	33
28	.717673	3.43	.930921	1.30	.786752	4.73	.213248	32
29	.717879	3.43	.930843	1.28	.787036	4.72	.212964	31
30	.718085	3.43	.930766	1.30	.787319	4.73	.212681	30
31	9.718291	3.43	9.930688	1.28	9.787603	4.72	10.212397	29
32	.718497	3.43	.930611	1.30	.787886	4.73	.212114	28
33	.718703	3.43	.930533	1.28	.788170	4.72	.211830	27
34	.718909	3.42	.930456	1.30	.788453	4.72	.211547	26
35	.719114	3.43	.930378	1.30	.788736	4.72	.211264	25
36	.719320	3.42	.930300	1.28	.789019	4.72	.210981	24
37	.719525	3.42	.930223	1.30	.789302	4.72	.210698	23
38	.719730	3.42	.930145	1.30	.789585	4.72	.210415	22
39	.719935	3.42	.930067	1.30	.789868	4.72	.210132	21
40	.720140	3.42	.929989	1.30	.790151	4.72	.209849	20
41	9.720345	3.40	9.929911	1.30	9.790434	4.70	10.209566	19
42	.720549	3.42	.929833	1.30	.790716	4.72	.209284	18
43	.720754	3.40	.929755	1.30	.790999	4.70	.209001	17
44	.720958	3.40	.929677	1.30	.791281	4.70	.208719	16
45	.721162	3.40	.929599	1.30	.791563	4.72	.208437	15
46	.721366	3.40	.929521	1.32	.791846	4.70	.208154	14
47	.721570	3.40	.929442	1.30	.792128	4.70	.207872	13
48	.721774	3.40	.929364	1.30	.792410	4.70	.207590	12
49	.721978	3.38	.929286	1.32	.792692	4.70	.207308	11
50	.722181	3.40	.929207	1.30	.792974	4.70	.207026	10
51	9.722385	3.38	9.929129	1.32	9.793256	4.70	10.206744	9
52	.722588	3.38	.929050	1.30	.793538	4.68	.206462	8
53	.722791	3.38	.928972	1.32	.793819	4.70	.206181	7
54	.722994	3.38	.928893	1.30	.794101	4.70	.205899	6
55	.723197	3.38	.928815	1.32	.794383	4.68	.205617	5
56	.723400	3.38	.928736	1.32	.794664	4.70	.205336	4
57	.723603	3.37	.928657	1.32	.794946	4.68	.205054	3
58	.723805	3.37	.928578	1.32	.795227	4.68	.204773	2
59	.724007	3.38	.928499	1.32	.795508	4.68	.204492	1
60	9.724210		9.928420		9.795789		10.204211	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.724210	3.37	9.928420	1.30	9.795789	4.68	10.204211	60
1	.724412	3.37	.928342	1.32	.796070	4.68	.203930	59
2	.724614	3.37	.928263	1.33	.796351	4.68	.203649	58
3	.724816	3.35	.928183	1.32	.796632	4.68	.203368	57
4	.725017	3.37	.928104	1.32	.796913	4.68	.203087	56
5	.725219	3.35	.928025	1.32	.797194	4.67	.202806	55
6	.725420	3.37	.927946	1.32	.797474	4.68	.202526	54
7	.725622	3.35	.927867	1.33	.797755	4.68	.202245	53
8	.725823	3.35	.927787	1.32	.798036	4.67	.201964	52
9	.726024	3.35	.927708	1.32	.798316	4.67	.201684	51
10	.726225	3.35	.927629	1.33	.798596	4.68	.201404	50
11	9.726426	3.33	9.927549	1.32	9.798877	4.67	10.201123	49
12	.726626	3.35	.927470	1.33	.799157	4.67	.200843	48
13	.726827	3.33	.927390	1.33	.799437	4.67	.200563	47
14	.727027	3.35	.927310	1.32	.799717	4.67	.200283	46
15	.727228	3.33	.927231	1.33	.799997	4.67	.200003	45
16	.727428	3.33	.927151	1.33	.800277	4.67	.199723	44
17	.727628	3.33	.927071	1.33	.800557	4.65	.199443	43
18	.727828	3.32	.926991	1.33	.800836	4.67	.199164	42
19	.728027	3.33	.926911	1.33	.801116	4.67	.198884	41
20	.728227	3.33	.926831	1.33	.801396	4.65	.198604	40
21	9.728427	3.32	9.926751	1.33	9.801675	4.67	10.198325	39
22	.728626	3.32	.926671	1.33	.801955	4.65	.198045	38
23	.728825	3.32	.926591	1.33	.802234	4.65	.197766	37
24	.729024	3.32	.926511	1.33	.802513	4.65	.197487	36
25	.729223	3.32	.926431	1.33	.802792	4.67	.197208	35
26	.729422	3.32	.926351	1.35	.803072	4.65	.196928	34
27	.729621	3.32	.926270	1.33	.803351	4.65	.196649	33
28	.729820	3.30	.926190	1.33	.803630	4.65	.196370	32
29	.730018	3.32	.926110	1.35	.803909	4.63	.196091	31
30	.730217	3.30	.926029	1.33	.804187	4.65	.195813	30
31	9.730415	3.30	9.925949	1.35	9.804466	4.65	10.195534	29
32	.730613	3.30	.925868	1.33	.804745	4.63	.195255	28
33	.730811	3.30	.925788	1.35	.805023	4.65	.194977	27
34	.731009	3.28	.925707	1.35	.805302	4.63	.194698	26
35	.731206	3.30	.925626	1.35	.805580	4.65	.194420	25
36	.731404	3.30	.925545	1.33	.805859	4.63	.194141	24
37	.731602	3.28	.925465	1.35	.806137	4.63	.193863	23
38	.731799	3.28	.925384	1.35	.806415	4.63	.193585	22
39	.731996	3.28	.925303	1.35	.806693	4.63	.193307	21
40	.732193	3.28	.925222	1.35	.806971	4.63	.193029	20
41	9.732390	3.28	9.925141	1.35	9.807249	4.63	10.192751	19
42	.732587	3.28	.925060	1.35	.807527	4.63	.192473	18
43	.732784	3.27	.924979	1.37	.807805	4.63	.192195	17
44	.732980	3.28	.924897	1.35	.808083	4.63	.191917	16
45	.733177	3.27	.924816	1.35	.808361	4.62	.191639	15
46	.733373	3.27	.924735	1.35	.808638	4.63	.191362	14
47	.733569	3.27	.924654	1.37	.808916	4.62	.191084	13
48	.733765	3.27	.924572	1.35	.809193	4.63	.190807	12
49	.733961	3.27	.924491	1.37	.809471	4.62	.190529	11
50	.734157	3.27	.924409	1.35	.809748	4.62	.190252	10
51	9.734353	3.27	9.924328	1.37	9.810025	4.62	10.189975	9
52	.734549	3.25	.924246	1.37	.810302	4.63	.189698	8
53	.734744	3.25	.924164	1.35	.810580	4.62	.189420	7
54	.734939	3.27	.924083	1.37	.810857	4.62	.189143	6
55	.735135	3.25	.924001	1.37	.811134	4.60	.188866	5
56	.735330	3.25	.923919	1.37	.811410	4.62	.188590	4
57	.735525	3.23	.923837	1.37	.811687	4.62	.188313	3
58	.735719	3.25	.923755	1.37	.811964	4.62	.188036	2
59	.735914	3.25	.923673	1.37	.812241	4.60	.187759	1
60	9.736109		9.923591		9.812517		10.187483	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.736109	3.23	9.923591	1.37	9.812517	4.62	10.187483	60
1	.736303	3.25	.923509	1.37	.812794	4.60	.187206	59
2	.736498	3.23	.923427	1.37	.813070	4.62	.186930	58
3	.736692	3.23	.923345	1.37	.813347	4.60	.186653	57
4	.736886	3.23	.923263	1.37	.813623	4.60	.186377	56
5	.737080	3.23	.923181	1.38	.813899	4.62	.186101	55
6	.737274	3.22	.923098	1.37	.814176	4.60	.185824	54
7	.737467	3.23	.923016	1.38	.814452	4.60	.185548	53
8	.737661	3.23	.922933	1.37	.814728	4.60	.185272	52
9	.737855	3.22	.922851	1.38	.815004	4.60	.184996	51
10	.738048	3.22	.922768	1.37	.815280	4.58	.184720	50
11	9.738241	3.22	9.922686	1.38	9.815555	4.60	10.184445	49
12	.738434	3.22	.922603	1.38	.815831	4.60	.184169	48
13	.738627	3.22	.922520	1.37	.816107	4.58	.183893	47
14	.738820	3.22	.922438	1.38	.816382	4.60	.183618	46
15	.739013	3.22	.922355	1.38	.816658	4.58	.183342	45
16	.739206	3.20	.922272	1.38	.816933	4.60	.183067	44
17	.739398	3.20	.922189	1.38	.817209	4.58	.182791	43
18	.739590	3.22	.922106	1.38	.817484	4.58	.182516	42
19	.739783	3.20	.922023	1.38	.817759	4.60	.182241	41
20	.739975	3.20	.921940	1.38	.818035	4.58	.181965	40
21	9.740167	3.20	9.921857	1.38	9.818310	4.58	10.181690	39
22	.740359	3.18	.921774	1.38	.818585	4.58	.181415	38
23	.740550	3.20	.921691	1.40	.818860	4.58	.181140	37
24	.740742	3.20	.921607	1.38	.819135	4.58	.180865	36
25	.740934	3.18	.921524	1.38	.819410	4.57	.180590	35
26	.741125	3.18	.921441	1.40	.819684	4.58	.180316	34
27	.741316	3.20	.921357	1.38	.819959	4.58	.180041	33
28	.741508	3.18	.921274	1.40	.820234	4.57	.179766	32
29	.741699	3.17	.921190	1.38	.820508	4.58	.179492	31
30	.741889	3.18	.921107	1.40	.820783	4.57	.179217	30
31	9.742080	3.18	9.921023	1.40	9.821057	4.58	10.178943	29
32	.742271	3.18	.920939	1.38	.821332	4.57	.178668	28
33	.742462	3.17	.920856	1.40	.821606	4.57	.178394	27
34	.742652	3.17	.920772	1.40	.821880	4.57	.178120	26
35	.742842	3.18	.920688	1.40	.822154	4.58	.177846	25
36	.743033	3.17	.920604	1.40	.822429	4.57	.177571	24
37	.743223	3.17	.920520	1.40	.822703	4.57	.177297	23
38	.743413	3.15	.920436	1.40	.822977	4.57	.177023	22
39	.743602	3.17	.920352	1.40	.823251	4.55	.176749	21
40	.743792	3.17	.920268	1.40	.823524	4.57	.176476	20
41	9.743982	3.15	9.920184	1.42	9.823798	4.57	10.176202	19
42	.744171	3.17	.920099	1.40	.824072	4.55	.175928	18
43	.744361	3.15	.920015	1.40	.824345	4.57	.175655	17
44	.744550	3.15	.919931	1.42	.824619	4.57	.175381	16
45	.744739	3.15	.919846	1.40	.824893	4.55	.175107	15
46	.744928	3.15	.919762	1.42	.825166	4.55	.174834	14
47	.745117	3.15	.919677	1.40	.825439	4.57	.174561	13
48	.745306	3.13	.919593	1.42	.825713	4.55	.174287	12
49	.745494	3.15	.919508	1.40	.825986	4.55	.174014	11
50	.745683	3.13	.919424	1.42	.826259	4.55	.173741	10
51	9.745871	3.15	9.919339	1.42	9.826532	4.55	10.173468	9
52	.746060	3.13	.919254	1.42	.826805	4.55	.173195	8
53	.746248	3.13	.919169	1.40	.827078	4.55	.172922	7
54	.746436	3.13	.919085	1.42	.827351	4.55	.172649	6
55	.746624	3.13	.919000	1.42	.827624	4.55	.172376	5
56	.746812	3.12	.918915	1.42	.827897	4.55	.172103	4
57	.746999	3.13	.918830	1.42	.828170	4.53	.171830	3
58	.747187	3.12	.918745	1.43	.828442	4.55	.171558	2
59	.747374	3.13	.918659	1.42	.828715	4.53	.171285	1
60	9.747562		9.918574		9.828987		10.171013	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.747562	3.12	9.918574	1.42	9.828987	4.55	10.171013	60
1	.747749	3.12	.918489	1.42	.829260	4.53	.170740	59
2	.747936	3.12	.918404	1.43	.829532	4.55	.170468	58
3	.748123	3.12	.918318	1.42	.829805	4.53	.170195	57
4	.748310	3.12	.918233	1.43	.830077	4.53	.169923	56
5	.748497	3.10	.918147	1.42	.830349	4.53	.169651	55
6	.748683	3.12	.918062	1.43	.830621	4.53	.169379	54
7	.748870	3.10	.917976	1.42	.830893	4.53	.169107	53
8	.749056	3.12	.917891	1.43	.831165	4.53	.168835	52
9	.749243	3.10	.917805	1.43	.831437	4.53	.168563	51
10	.749429	3.10	.917719	1.42	.831709	4.53	.168291	50
11	9.749615	3.10	9.917634	1.43	9.831981	4.53	10.168019	49
12	.749801	3.10	.917548	1.43	.832253	4.53	.167747	48
13	.749987	3.08	.917462	1.43	.832525	4.52	.167475	47
14	.750172	3.10	.917376	1.43	.832796	4.53	.167204	46
15	.750358	3.08	.917290	1.43	.833068	4.52	.166932	45
16	.750543	3.10	.917204	1.43	.833339	4.53	.166661	44
17	.750729	3.08	.917118	1.43	.833611	4.52	.166389	43
18	.750914	3.08	.917032	1.43	.833882	4.53	.166118	42
19	.751099	3.08	.916946	1.45	.834154	4.52	.165846	41
20	.751284	3.08	.916859	1.43	.834425	4.52	.165575	40
21	9.751469	3.08	9.916773	1.43	9.834696	4.52	10.165304	39
22	.751654	3.08	.916687	1.45	.834967	4.52	.165033	38
23	.751839	3.07	.916600	1.43	.835238	4.52	.164762	37
24	.752023	3.08	.916514	1.45	.835509	4.52	.164491	36
25	.752208	3.07	.916427	1.43	.835780	4.52	.164220	35
26	.752392	3.07	.916341	1.45	.836051	4.52	.163949	34
27	.752576	3.07	.916254	1.45	.836322	4.52	.163678	33
28	.752760	3.07	.916167	1.43	.836593	4.52	.163407	32
29	.752944	3.07	.916081	1.45	.836864	4.50	.163136	31
30	.753128	3.07	.915994	1.45	.837134	4.52	.162866	30
31	9.753312	3.05	9.915907	1.45	9.837405	4.50	10.162595	29
32	.753495	3.07	.915820	1.45	.837675	4.52	.162325	28
33	.753679	3.07	.915733	1.45	.837946	4.50	.162054	27
34	.753862	3.07	.915646	1.45	.838216	4.52	.161784	26
35	.754046	3.05	.915559	1.45	.838487	4.50	.161513	25
36	.754229	3.05	.915472	1.45	.838757	4.50	.161243	24
37	.754412	3.05	.915385	1.47	.839027	4.50	.160973	23
38	.754595	3.05	.915297	1.45	.839297	4.52	.160703	22
39	.754778	3.03	.915210	1.45	.839568	4.50	.160432	21
40	.754960	3.05	.915123	1.47	.839838	4.50	.160162	20
41	9.755143	3.05	9.915035	1.45	9.840108	4.50	10.159892	19
42	.755326	3.03	.914948	1.47	.840378	4.50	.159622	18
43	.755508	3.03	.914860	1.45	.840648	4.48	.159352	17
44	.755690	3.03	.914773	1.47	.840917	4.50	.159083	16
45	.755872	3.03	.914685	1.45	.841187	4.50	.158813	15
46	.756054	3.03	.914598	1.47	.841457	4.50	.158543	14
47	.756236	3.03	.914510	1.47	.841727	4.48	.158273	13
48	.756418	3.03	.914422	1.47	.841996	4.50	.158004	12
49	.756600	3.03	.914334	1.47	.842266	4.48	.157734	11
50	.756782	3.02	.914246	1.47	.842535	4.50	.157465	10
51	9.756963	3.02	9.914158	1.47	9.842805	4.48	10.157195	9
52	.757144	3 03	.914070	1.47	.843074	4.48	156926	8
53	.757326	3.02	.913982	1.47	.843343	4.48	.156657	7
54	.757507	3.02	.913894	1.47	.843612	4.50	.156388	6
55	.757688	3.02	.913806	1.47	.843882	4.48	.156118	5
56	.757869	3.02	.913718	1.47	.844151	4.48	.155849	4
57	.758050	3.00	.913630	1.48	.844420	4.48	.155580	3
58	.758230	3.02	913541	1.47	.844689	4.48	.155311	2
59	.758411	3.00	.913453	1.47	.844958	4.48	.155042	1
60	9.758591		9.913365		9.845227		10.154773	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.758591	3.02	9.913365	1.48	9.845227	4.48	10.154773	60
1	.758772	3.00	.913276	1.48	.845496	4.47	.154504	59
2	.758952	3.00	.913187	1.47	.845764	4.48	.154236	58
3	.759132	3.00	.913099	1.48	.846033	4.48	.153967	57
4	.759312	3.00	.913010	1.47	.846302	4.47	.153698	56
5	.759492	3.00	.912922	1.48	.846570	4.48	.153430	55
6	.759672	3.00	.912833	1.48	.846839	4.48	.153161	54
7	.759852	2.98	.912744	1.48	.847108	4.47	.152892	53
8	.760031	3.00	.912655	1.48	.847376	4.47	.152624	52
9	.760211	2.98	.912566	1.48	.847644	4.48	.152356	51
10	.760390	2.98	.912477	1.48	.847913	4.47	.152087	50
11	9.760569	2.98	9.912388	1.48	9.848181	4.47	10.151819	49
12	.760748	2.98	.912299	1.48	.848449	4.47	.151551	48
13	.760927	2.98	.912210	1.48	.848717	4.48	.151283	47
14	.761106	2.98	.912121	1.50	.848986	4.47	.151014	46
15	.761285	2.98	.912031	1.48	.849254	4.47	.150746	45
16	.761464	2.97	.911942	1.48	.849522	4.47	.150478	44
17	.761642	2.98	.911853	1.50	.849790	4.45	.150210	43
18	.761821	2.97	.911763	1.48	.850057	4.47	.149943	42
19	.761999	2.97	.911674	1.50	.850325	4.47	.149675	41
20	.762177	2.98	.911584	1.48	.850593	4.47	.149407	40
21	9.762356	2.97	9.911495	1.50	9.850861	4.47	10.149139	39
22	.762534	2.97	.911405	1.50	.851129	4.45	.148871	38
23	.762712	2.95	.911315	1.48	.851396	4.47	.148604	37
24	.762889	2.97	.911226	1.50	.851664	4.45	.148336	36
25	.763067	2.97	.911136	1.50	.851931	4.47	.148069	35
26	.763245	2.95	.911046	1.50	.852199	4.45	.147801	34
27	.763422	2.97	.910956	1.50	.852466	4.45	.147534	33
28	.763600	2.95	.910866	1.50	.852733	4.47	.147267	32
29	.763777	2.95	.910776	1.50	.853001	4.45	.146999	31
30	.763954	2.95	.910686	1.50	.853268	4.45	.146732	30
31	9.764131	2.95	9.910596	1.50	9.853535	4.45	10.146465	29
32	.764308	2.95	.910506	1.52	.853802	4.45	.146198	28
33	.764485	2.95	.910415	1.50	.854069	4.45	.145931	27
34	.764662	2.93	.910325	1.50	.854336	4.45	.145664	26
35	.764838	2.95	.910235	1.52	.854603	4.45	.145397	25
36	.765015	2.93	.910144	1.50	.854870	4.45	.145130	24
37	.765191	2.93	.910054	1.52	.855137	4.45	.144863	23
38	.765367	2.95	.909963	1.50	.855404	4.45	.144596	22
39	.765544	2.93	.909873	1.52	.855671	4.45	.144329	21
40	.765720	2.93	.909782	1.52	.855938	4.43	.144062	20
41	9.765896	2.93	9.909691	1.50	9.856204	4.45	10.143796	19
42	.766072	2.92	.909601	1.52	.856471	4.43	.143529	18
43	.766247	2.93	.909510	1.52	.856737	4.45	.143263	17
44	.766423	2.92	.909419	1.52	.857004	4.43	.142996	16
45	.766598	2.93	.909328	1.52	.857270	4.45	.142730	15
46	.766774	2.92	.909237	1.52	.857537	4.43	.142463	14
47	.766949	2.92	.909146	1.52	.857803	4.43	.142197	13
48	.767124	2.93	.909055	1.52	.858069	4.45	.141931	12
49	.767300	2.92	.908964	1.52	.858336	4.43	.141664	11
50	.767475	2.90	.908873	1.53	.858602	4.43	.141398	10
51	9.767649	2.92	9.908781	1.52	9.858868	4.43	10.141132	9
52	.767824	2.92	.908690	1.52	.859134	4.43	.140866	8
53	.767999	2.90	.908599	1.53	.859400	4.43	.140600	7
54	.768173	2.92	.908507	1.52	.859666	4.43	.140334	6
55	.768348	2.90	.908416	1.53	.859932	4.43	.140068	5
56	.768522	2.92	.908324	1.52	.860198	4.43	.139802	4
57	.768697	2.90	.908233	1.53	.860464	4.43	.139536	3
58	.768871	2.90	.908141	1.53	.860730	4.42	.139270	2
59	.769045	2.90	.908049	1.52	.860995	4.43	.139005	1
60	9.769219		9.907958		9.861261		10.138739	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.769219	2.90	9.907958	1.53	9.861261	4.43	10.138739	60
1	.769393	2.88	.907866	1.53	.861527	4.42	.138473	59
2	.769566	2.90	.907774	1.53	.861792	4.43	.138208	58
3	.769740	2.88	.907682	1.53	.862058	4.42	.137942	57
4	.769913	2.90	.907590	1.53	.862323	4.43	.137677	56
5	.770087	2.88	.907498	1.53	.862589	4.42	.137411	55
6	.770260	2.88	.907406	1.53	.862854	4.42	.137146	54
7	.770433	2.88	.907314	1.53	.863119	4.43	.136881	53
8	.770606	2.88	.907222	1.55	.863385	4.42	.136615	52
9	.770779	2.88	.907129	1.53	.863650	4.42	.136350	51
10	.770952	2.88	.907037	1.53	.863915	4.42	.136085	50
11	9.771125	2.88	9.906945	1.55	9.864180	4.42	10.135820	49
12	.771298	2.87	.906852	1.53	.864445	4.42	.135555	48
13	.771470	2.88	.906760	1.55	.864710	4.42	.135290	47
14	.771643	2.87	.906667	1.53	.864975	4.42	.135025	46
15	.771815	2.87	.906575	1.55	.865240	4.42	.134760	45
16	.771987	2.87	.906482	1.55	.865505	4.42	.134495	44
17	.772159	2.87	.906389	1.55	.865770	4.42	.134230	43
18	.772331	2.87	.906296	1.53	.866035	4.42	.133965	42
19	.772503	2.87	.906204	1.55	.866300	4.40	.133700	41
20	.772675	2.87	.906111	1.55	.866564	4.42	.133436	40
21	9.772847	2.85	9.906018	1.55	9.866829	4.42	10.133171	39
22	.773018	2.87	.905925	1.55	.867094	4.40	.132906	38
23	.773190	2.85	.905832	1.55	.867358	4.42	.132642	37
24	.773361	2.87	.905739	1.57	.867623	4.40	.132377	36
25	.773533	2.85	.905645	1.55	.867887	4.42	.132113	35
26	.773704	2.85	.905552	1.55	.868152	4.40	.131848	34
27	.773875	2.85	.905459	1.55	.868416	4.40	.131584	33
28	.774046	2.85	.905366	1.57	.868680	4.42	.131320	32
29	.774217	2.85	.905272	1.55	.868945	4.40	.131055	31
30	.774388	2.83	.905179	1.57	.869209	4.40	.130791	30
31	9.774558	2.85	9.905085	1.55	9.869473	4.40	10.130527	29
32	.774729	2.83	.904992	1.57	.869737	4.40	.130263	28
33	.774899	2.85	.904898	1.57	.870001	4.40	.129999	27
34	.775070	2.83	.904804	1.55	.870265	4.40	.129735	26
35	.775240	2.83	.904711	1.57	.870529	4.40	.129471	25
36	.775410	2.83	.904617	1.57	.870793	4.40	.129207	24
37	.775580	2.83	.904523	1.57	.871057	4.40	.128943	23
38	.775750	2.83	.904429	1.57	.871321	4.40	.128679	22
39	.775920	2.83	.904335	1.57	.871585	4.40	.128415	21
40	.776090	2.82	.904241	1.57	.871849	4.38	.128151	20
41	9.776259	2.83	9.904147	1.57	9.872112	4.40	10.127888	19
42	.776429	2.82	.904053	1.57	.872376	4.40	.127624	18
43	.776598	2.83	.903959	1.58	.872640	4.38	.127360	17
44	.776768	2.82	.903864	1.57	.872903	4.40	.127097	16
45	.776937	2.82	.903770	1.57	.873167	4.38	.126833	15
46	.777106	2.82	.903676	1.58	.873430	4.40	.126570	14
47	.777275	2.82	.903581	1.57	.873694	4.38	.126306	13
48	.777444	2.82	.903487	1.58	.873957	4.38	.126043	12
49	.777613	2.80	.903392	1.57	.874220	4.40	.125780	11
50	.777781	2.82	.903298	1.58	.874484	4.38	.125516	10
51	9.777950	2.82	9.903203	1.58	9.874747	4.38	10.125253	9
52	.778119	2.80	.903108	1.57	.875010	4.38	.124990	8
53	.778287	2.80	.903014	1.58	.875273	4.40	.124727	7
54	.778455	2.82	.902919	1.58	.875537	4.38	.124463	6
55	.778624	2.80	.902824	1.58	.875800	4.38	.124200	5
56	.778792	2.80	.902729	1.58	.876063	4.38	.123937	4
57	.778960	2.80	.902634	1.58	.876326	4.38	.123674	3
58	.779128	2.78	.902539	1.58	.876589	4.38	.123411	2
59	.779295	2.80	.902444	1.58	.876852	4.37	.123148	1
60	9.779463		9.902349		9.877114		10.122886	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.779463	2.80	9.902349	1.60	9.877114	4.38	10.122886	60
1	.779631	2.78	.902253	1.58	.877377	4.38	.122623	59
2	.779798	2.80	.902158	1.58	.877640	4.38	.122360	58
3	.779966	2.78	.902063	1.60	.877903	4.37	.122097	57
4	.780133	2.78	.901967	1.58	.878165	4.38	.121835	56
5	.780300	2.78	.901872	1.60	.878428	4.38	.121572	55
6	.780467	2.78	.901776	1.58	.878691	4.37	.121309	54
7	.780634	2.78	.901681	1.60	.878953	4.38	.121047	53
8	.780801	2.78	.901585	1.58	.879216	4.37	.120784	52
9	.780968	2.77	.901490	1.60	.879478	4.38	.120522	51
10	.781134	2.78	.901394	1.60	.879741	4.37	.120259	50
11	9.781301	2.78	9.901298	1.60	9.880003	4.37	10.119997	49
12	.781468	2.77	.901202	1.60	.880265	4.38	.119735	48
13	.781634	2.77	.901106	1.60	.880528	4.37	.119472	47
14	.781800	2.77	.901010	1.60	.880790	4.37	.119210	46
15	.781966	2.77	.900914	1.60	.881052	4.37	.118948	45
16	.782132	2.77	.900818	1.60	.881314	4.38	.118686	44
17	.782298	2.77	.900722	1.60	.881577	4.37	.118423	43
18	.782464	2.77	.900626	1.62	.881839	4.37	.118161	42
19	.782630	2.77	.900529	1.60	.882101	4.37	.117899	41
20	.782796	2.75	.900433	1.60	.882363	4.37	.117637	40
21	9.782961	2.77	9.900337	1.62	9.882625	4.37	10.117375	39
22	.783127	2.75	.900240	1.60	.882887	4.35	.117113	38
23	.783292	2.77	.900144	1.62	.883148	4.37	.116852	37
24	.783458	2.75	.900047	1.60	.883410	4.37	.116590	36
25	.783623	2.75	.899951	1.62	.883672	4.37	.116328	35
26	.783788	2.75	.899854	1.62	.883934	4.37	.116066	34
27	.783953	2.75	.899757	1.62	.884196	4.35	.115804	33
28	.784118	2.73	.899660	1.60	.884457	4.37	.115543	32
29	.784282	2.75	.899564	1.62	.884719	4.35	.115281	31
30	.784447	2.75	.899467	1.62	.884980	4.37	.115020	30
31	9.784612	2.73	9.899370	1.62	9.885242	4.37	10.114758	29
32	.784776	2.75	.899273	1.62	.885504	4.35	.114496	28
33	.784941	2.73	.899176	1.63	.885765	4.35	.114235	27
34	.785105	2.73	.899078	1.62	.886026	4.37	.113974	26
35	.785269	2.73	.898981	1.62	.886288	4.35	.113712	25
36	.785433	2.73	.898884	1.62	.886549	4.37	.113451	24
37	.785597	2.73	.898787	1.63	.886811	4.35	.113189	23
38	.785761	2.73	.898689	1.62	.887072	4.35	.112928	22
39	.785925	2.73	.898592	1.63	.887333	4.35	.112667	21
40	.786089	2.72	.898494	1.62	.887594	4.35	.112406	20
41	9.786252	2.73	9.898397	1.63	9.887855	4.35	10.112145	19
42	.786416	2.72	.898299	1.62	.888116	4.37	.111884	18
43	.786579	2.72	.898202	1.63	.888378	4.35	.111622	17
44	.786742	2.73	.898104	1.63	.888639	4.35	.111361	16
45	.786906	2.72	.898006	1.63	.888900	4.35	.111100	15
46	.787069	2.72	.897908	1.63	.889161	4.33	.110839	14
47	.787232	2.72	.897810	1.63	.889421	4.35	.110579	13
48	.787395	2.70	.897712	1.63	.889682	4.35	.110318	12
49	.787557	2.72	.897614	1.63	.889943	4.35	.110057	11
50	.787720	2.72	.897516	1.63	.890204	4.35	.109796	10
51	9.787883	2.70	9.897418	1.63	9.890465	4.33	10.109535	9
52	.788045	2.72	.897320	1.63	.890725	4.35	.109275	8
53	.788208	2.70	.897222	1.65	.890986	4.35	.109014	7
54	.788370	2.70	.897123	1.63	.891247	4.33	.108753	6
55	.788532	2.70	.897025	1.65	.891507	4.35	.108493	5
56	.788694	2.70	.896926	1.63	.891768	4.33	.108232	4
57	.788856	2.70	.896828	1.65	.892028	4.35	.107972	3
58	.789018	2.70	.896729	1.63	.892289	4.33	.107711	2
59	.789180	2.70	.896631	1.65	.892549	4.35	.107451	1
60	9.789342		9.896532		9.892810		10.107190	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.789342	2.70	9.896532	1.65	9.892810	4.33	10.107190	60
1	.789504	2.68	.896433	1.63	.893070	4.35	.106930	59
2	.789665	2.70	.896335	1.65	.893331	4.33	.106669	58
3	.789827	2.68	.896236	1.65	.893591	4.33	.106409	57
4	.789988	2.68	.896137	1.65	.893851	4.33	.106149	56
5	.790149	2.68	.896038	1.65	.894111	4.35	.105889	55
6	.790310	2.68	.895939	1.65	.894372	4.33	.105628	54
7	.790471	2.68	.895840	1.65	.894632	4.33	.105368	53
8	.790632	2.68	.895741	1.67	.894892	4.33	.105108	52
9	.790793	2.68	.895641	1.65	.895152	4.33	.104848	51
10	.790954	2.68	.895542	1.65	.895412	4.33	.104588	50
11	9.791115	2.67	9.895443	1.67	9.895672	4.33	10.104328	49
12	.791275	2.68	.895343	1.65	.895932	4.33	.104068	48
13	.791436	2.67	.895244	1.65	.896192	4.33	.103808	47
14	.791596	2.68	.895145	1.67	.896452	4.33	.103548	46
15	.791757	2.67	.895045	1.67	.896712	4.32	.103288	45
16	.791917	2.67	.894945	1.65	.896971	4.33	.103029	44
17	.792077	2.67	.894846	1.67	.897231	4.33	.102769	43
18	.792237	2.67	.894746	1.67	.897491	4.33	.102509	42
19	.792397	2.67	.894646	1.67	.897751	4.32	.102249	41
20	.792557	2.65	.894546	1.67	.898010	4.33	.101990	40
21	9.792716	2.67	9.894446	1.67	9.898270	4.33	10.101730	39
22	.792876	2.65	.894346	1.67	.898530	4.32	.101470	38
23	.793035	2.67	.894246	1.67	.898789	4.33	.101211	37
24	.793195	2.65	.894146	1.67	.899049	4.32	.100951	36
25	.793354	2.67	.894046	1.67	.899308	4.33	.100692	35
26	.793514	2.65	.893946	1.67	.899568	4.32	.100432	34
27	.793673	2.65	.893846	1.68	.899827	4.33	.100173	33
28	.793832	2.65	.893745	1.67	.900087	4.32	.099913	32
29	.793991	2.65	.893645	1.68	.900346	4.32	.099654	31
30	.794150	2.63	.893544	1.67	.900605	4.32	.099395	30
31	9.794308	2.65	9.893444	1.68	9.900864	4.33	10.099136	29
32	.794467	2.65	.893343	1.67	.901124	4.32	.098876	28
33	.794626	2.63	.893243	1.68	.901383	4.32	.098617	27
34	.794784	2.63	.893142	1.68	.901642	4.32	.098358	26
35	.794942	2.65	.893041	1.68	.901901	4.32	.098099	25
36	.795101	2.63	.892940	1.68	.902160	4.33	.097840	24
37	.795259	2.63	.892839	1.67	.902420	4.32	.097580	23
38	.795417	2.63	.892739	1.68	.902679	4.32	.097321	22
39	.795575	2.63	.892638	1.70	.902938	4.32	.097062	21
40	.795733	2.63	.892536	1.68	.903197	4.32	.096803	20
41	9.795891	2.63	9.892435	1.68	9.903456	4.30	10.096544	19
42	.796049	2.62	.892334	1.68	.903714	4.32	.096286	18
43	.796206	2.63	.892233	1.68	.903973	4.32	.096027	17
44	.796364	2.62	.892132	1.70	.904232	4.32	.095768	16
45	.796521	2.63	.892030	1.68	.904491	4.32	.095509	15
46	.796679	2.62	.891929	1.70	.904750	4.30	.095250	14
47	.796836	2.62	.891827	1.68	.905008	4.32	.094992	13
48	.796993	2.62	.891726	1.70	.905267	4.32	.094733	12
49	.797150	2.62	.891624	1.68	.905526	4.32	.094474	11
50	.797307	2.62	.891523	1.70	.905785	4.30	.094215	10
51	9.797464	2.62	9.891421	1.70	9.906043	4.32	10.093957	9
52	.797621	2.60	.891319	1.70	.906302	4.30	.093698	8
53	.797777	2.62	.891217	1.70	.906560	4.32	.093440	7
54	.797934	2.62	.891115	1.70	.906819	4.30	.093181	6
55	.798091	2.60	.891013	1.70	.907077	4.32	.092923	5
56	.798247	2.60	.890911	1.70	.907336	4.30	.092664	4
57	.798403	2.62	.890809	1.70	.907594	4.32	.092406	3
58	.798560	2.60	.890707	1.70	.907853	4.30	.092147	2
59	.798716	2.60	.890605	1.70	.908111	4.30	.091889	1
60	9.798872		9.890503		9.908369		10.091631	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.798872	2.60	9.890503	1.72	9.908369	4.32	10.091631	60
1	.799028	2.60	.890400	1.70	.908628	4.30	.091372	59
2	.799184	2.58	.890298	1.72	.908886	4.30	.091114	58
3	.799339	2.60	.890195	1.70	.909144	4.30	.090856	57
4	.799495	2.60	.890093	1.72	.909402	4.30	.090598	56
5	.799651	2.58	.889990	1.70	.909660	4.30	.090340	55
6	.799806	2.60	.889888	1.72	.909918	4.32	.090082	54
7	.799962	2.58	.889785	1.72	.910177	4.30	.089823	53
8	.800117	2.58	.889682	1.72	.910435	4.30	.089565	52
9	.800272	2.58	.889579	1.70	.910693	4.30	.089307	51
10	.800427	2.58	.889477	1.72	.910951	4.30	.089049	50
11	9.800582	2.58	9.889374	1.72	9.911209	4.30	10.088791	49
12	.800737	2.58	.889271	1.72	.911467	4.30	.088533	48
13	.800892	2.58	.889168	1.73	.911725	4.28	.088275	47
14	.801047	2.57	.889064	1.72	.911982	4.30	.088018	46
15	.801201	2.58	.888961	1.72	.912240	4.30	.087760	45
16	.801356	2.58	.888858	1.72	.912498	4.30	.087502	44
17	.801511	2.57	.888755	1.73	.912756	4.30	.087244	43
18	.801665	2.57	.888651	1.72	.913014	4.28	.086986	42
19	.801819	2.57	.888548	1.73	.913271	4.30	.086729	41
20	.801973	2.58	.888444	1.72	.913529	4.30	.086471	40
21	9.802128	2.57	9.888341	1.73	9.913787	4.28	10.086213	39
22	.802282	2.57	.888237	1.72	.914044	4.30	.085956	38
23	.802436	2.55	.888134	1.73	.914302	4.30	.085698	37
24	.802589	2.57	.888030	1.73	.914560	4.28	.085440	36
25	.802743	2.57	.887926	1.73	.914817	4.30	.085183	35
26	.802897	2.55	.887822	1.73	.915075	4.28	.084925	34
27	.803050	2.57	.887718	1.73	.915332	4.30	.084668	33
28	.803204	2.55	.887614	1.73	.915590	4.28	.084410	32
29	.803357	2.57	.887510	1.73	.915847	4.28	.084153	31
30	.803511	2.55	.887406	1.73	.916104	4.30	.083896	30
31	9.803664	2.55	9.887302	1.73	9.916362	4.28	10.083638	29
32	.803817	2.55	.887198	1.75	.916619	4.30	.083381	28
33	.803970	2.55	.887093	1.73	.916877	4.28	.083123	27
34	.804123	2.55	.886989	1.73	.917134	4.28	.082866	26
35	.804276	2.55	.886885	1.75	.917391	4.28	.082609	25
36	.804428	2.55	.886780	1.73	.917648	4.30	.082352	24
37	.804581	2.55	.886676	1.75	.917906	4.28	.082094	23
38	.804734	2.53	.886571	1.75	.918163	4.28	.081837	22
39	.804886	2.55	.886466	1.73	.918420	4.28	.081580	21
40	.805039	2.53	.886362	1.75	.918677	4.28	.081323	20
41	9.805191	2.53	9.886257	1.75	9.918934	4.28	10.081066	19
42	.805343	2.53	.886152	1.75	.919191	4.28	.080809	18
43	.805495	2.53	.886047	1.75	.919448	4.28	.080552	17
44	.805647	2.53	.885942	1.75	.919705	4.28	.080295	16
45	.805799	2.53	.885837	1.75	.919962	4.28	.080038	15
46	.805951	2.53	.885732	1.75	.920219	4.28	.079781	14
47	.806103	2.52	.885627	1.75	.920476	4.28	.079524	13
48	.806254	2.53	.885522	1.77	.920733	4.28	.079267	12
49	.806406	2.52	.885416	1.75	.920990	4.28	.079010	11
50	.806557	2.53	.885311	1.77	.921247	4.27	.078753	10
51	9.806709	2.52	9.885205	1.75	9.921503	4.28	10.078497	9
52	.806860	2.52	.885100	1.77	.921760	4.28	.078240	8
53	.807011	2.53	.884994	1.75	.922017	4.28	.077983	7
54	.807163	2.52	.884889	1.77	.922274	4.27	.077726	6
55	.807314	2.52	.884783	1.77	.922530	4.28	.077470	5
56	.807465	2.50	.884677	1.75	.922787	4.28	.077213	4
57	.807615	2.52	.884572	1.77	.923044	4.27	.076956	3
58	.807766	2.52	.884466	1.77	.923300	4.28	.076700	2
59	.807917	2.50	.884360	1.77	.923557	4.28	.076443	1
60	9.808067		9.884254		9.923814		10.076186	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

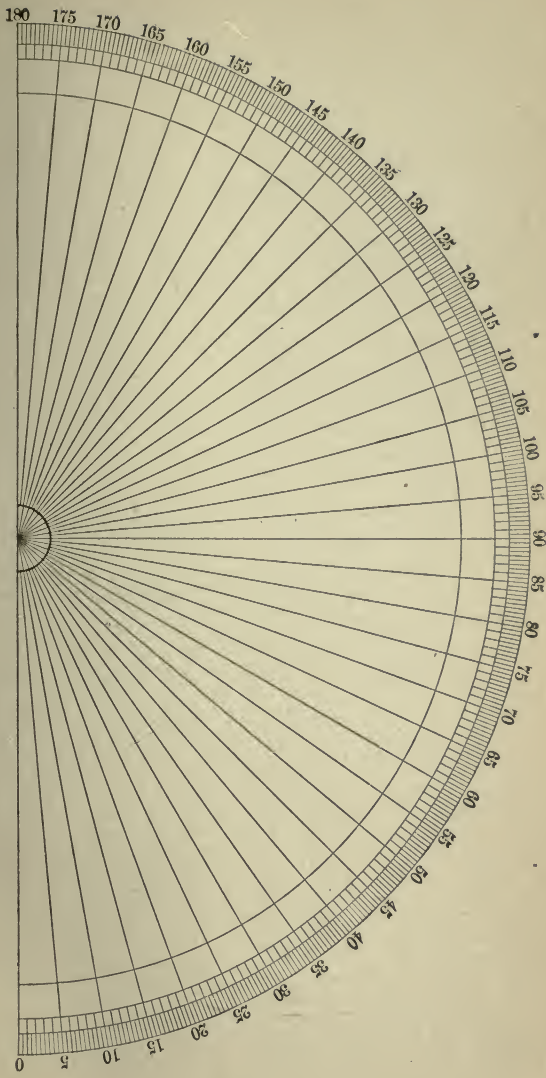
′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.808067	2.52	9.884254	1.77	9.923814	4.27	10.076186	60
1	.808218	2.50	.884148	1.77	.924070	4.28	.075930	59
2	.808368	2.52	.884042	1.77	.924327	4.27	.075673	58
3	.808519	2.50	.883936	1.78	.924583	4.28	.075417	57
4	.808669	2.50	.883829	1.77	.924840	4.27	.075160	56
5	.808819	2.50	.883723	1.77	.925096	4.27	.074904	55
6	.808969	2.50	.883617	1.78	.925352	4.28	.074648	54
7	.809119	2.50	.883510	1.77	.925609	4.27	.074391	53
8	.809269	2.50	.883404	1.78	.925865	4.28	.074135	52
9	.809419	2.50	.883297	1.77	.926122	4.27	.073878	51
10	.809569	2.48	.883191	1.78	.926378	4.27	.073622	50
11	9.809718	2.50	9.883084	1.78	9.926634	4.27	10.073366	49
12	.809868	2.48	.882977	1.77	.926890	4.28	.073110	48
13	.810017	2.50	.882871	1.78	.927147	4.27	.072853	47
14	.810167	2.48	.882764	1.78	.927403	4.27	.072597	46
15	.810316	2.48	.882657	1.78	.927659	4.27	.072341	45
16	.810465	2.48	.882550	1.78	.927915	4.27	.072085	44
17	.810614	2.48	.882443	1.78	.928171	4.27	.071829	43
18	.810763	2.48	.882336	1.78	.928427	4.28	.071573	42
19	.810912	2.48	.882229	1.80	.928684	4.27	.071316	41
20	.811061	2.48	.882121	1.78	.928940	4.27	.071060	40
21	9.811210	2.47	9.882014	1.78	9.929196	4.27	10.070804	39
22	.811358	2.48	.881907	1.80	.929452	4.27	.070548	38
23	.811507	2.47	.881799	1.78	.929708	4.27	.070292	37
24	.811655	2.48	.881692	1.80	.929964	4.27	.070036	36
25	.811804	2.47	.881584	1.78	.930220	4.25	.069780	35
26	.811952	2.47	.881477	1.80	.930475	4.27	.069525	34
27	.812100	2.47	.881369	1.80	.930731	4.27	.069269	33
28	.812248	2.47	.881261	1.80	.930987	4.27	.069013	32
29	.812396	2.47	.881153	1.78	.931243	4.27	.068757	31
30	.812544	2.47	.881046	1.80	.931499	4.27	.068501	30
31	9.812692	2.47	9.880938	1.80	9.931755	4.25	10.068245	29
32	.812840	2.47	.880830	1.80	.932010	4.27	.067990	28
33	.812988	2.45	.880722	1.82	.932266	4.27	.067734	27
34	.813135	2.47	.880613	1.80	.932522	4.27	.067478	26
35	.813283	2.45	.880505	1.80	.932778	4.25	.067222	25
36	.813430	2.47	.880397	1.80	.933033	4.27	.066967	24
37	.813578	2.45	.880289	1.82	.933289	4.27	.066711	23
38	.813725	2.45	.880180	1.80	.933545	4.25	.066455	22
39	.813872	2.45	.880072	1.82	.933800	4.27	.066200	21
40	.814019	2.45	.879963	1.80	.934056	4.25	.065944	20
41	9.814166	2.45	9.879855	1.82	9.934311	4.27	10.065689	19
42	.814313	2.45	.879746	1.82	.934567	4.25	.065433	18
43	.814460	2.45	.879637	1.80	.934822	4.27	.065178	17
44	.814607	2.43	.879529	1.82	.935078	4.25	.064922	16
45	.814753	2.45	.879420	1.82	.935333	4.27	.064667	15
46	.814900	2.43	.879311	1.82	.935589	4.25	.064411	14
47	.815046	2.45	.879202	1.82	.935844	4.27	.064156	13
48	.815193	2.43	.879093	1.82	.936100	4.25	.063900	12
49	.815339	2.43	.878984	1.82	.936355	4.27	.063645	11
50	.815485	2.45	.878875	1.82	.936611	4.25	.063389	10
51	9.815632	2.43	9.878766	1.83	9.936866	4.25	10.063134	9
52	.815778	2.43	.878656	1.82	.937121	4.27	.062879	8
53	.815924	2.42	.878547	1.82	.937377	4.25	.062623	7
54	.816069	2.43	.878438	1.83	.937632	4.25	.062368	6
55	.816215	2.43	.878328	1.82	.937887	4.25	.062113	5
56	.816361	2.43	.878219	1.83	.938142	4.27	.061858	4
57	.816507	2.42	.878109	1.83	.938398	4.25	.061602	3
58	.816652	2.43	.877999	1.82	.938653	4.25	.061347	2
59	.816798	2.42	.877890	1.83	.938908	4.25	.061092	1
60	9.816943		9.877780		9.939163		10.060837	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.816943	2.42	9.877780	1.83	9.939163	4.25	10.060837	60
1	.817088	2.42	.877670	1.83	.939418	4.25	.060582	59
2	.817233	2.43	.877560	1.83	.939673	4.25	.060327	58
3	.817379	2.42	.877450	1.83	.939928	4.25	.060072	57
4	.817524	2.40	.877340	1.83	.940183	4.27	.059817	56
5	.817668	2.42	.877230	1.83	.940439	4.25	.059561	55
6	.817813	2.42	.877120	1.83	.940694	4.25	.059306	54
7	.817958	2.42	.877010	1.85	.940949	4.25	.059051	53
8	.818103	2.40	.876899	1.83	.941204	4.25	.058796	52
9	.818247	2.42	.876789	1.85	.941459	4.23	.058541	51
10	.818392	2.40	.876678	1.83	.941713	4.25	.058287	50
11	9.818536	2.42	9.876568	1.85	9.941968	4.25	10.058032	49
12	.818681	2.40	.876457	1.83	.942223	4.25	.057777	48
13	.818825	2.40	.876347	1.85	.942478	4.25	.057522	47
14	.818969	2.40	.876236	1.85	.942733	4.25	.057267	46
15	.819113	2.40	.876125	1.85	.942988	4.25	.057012	45
16	.819257	2.40	.876014	1.83	.943243	4.25	.056757	44
17	.819401	2.40	.875904	1.85	.943498	4.23	.056502	43
18	.819545	2.40	.875793	1.85	.943752	4.25	.056248	42
19	.819689	2.38	.875682	1.85	.944007	4.25	.055993	41
20	.819832	2.40	.875571	1.87	.944262	4.25	.055738	40
21	9.819976	2.40	9.875459	1.85	9.944517	4.23	10.055483	39
22	.820120	2.38	.875348	1.85	.944771	4.25	.055229	38
23	.820263	2.38	.875237	1.85	.945026	4.25	.054974	37
24	.820406	2.40	.875126	1.87	.945281	4.23	.054719	36
25	.820550	2.38	.875014	1.85	.945535	4.25	.054465	35
26	.820693	2.38	.874903	1.87	.945790	4.25	.054210	34
27	.820836	2.38	.874791	1.85	.946045	4.23	.053955	33
28	.820979	2.38	.874680	1.87	.946299	4.25	.053701	32
29	.821122	2.38	.874568	1.87	.946554	4.23	.053446	31
30	.821265	2.37	.874456	1.87	.946808	4.25	.053192	30
31	9.821407	2.38	9.874344	1.87	9.947063	4.25	10.052937	29
32	.821550	2.38	.874232	1.85	.947318	4.23	.052682	28
33	.821693	2.37	.874121	1.87	.947572	4.25	.052428	27
34	.821835	2.37	.874009	1.88	.947827	4.23	.052173	26
35	.821977	2.38	.873896	1.87	.948081	4.23	.051919	25
36	.822120	2.37	.873784	1.87	.948335	4.25	.051665	24
37	.822262	2.37	.873672	1.87	.948590	4.23	.051410	23
38	.822404	2.37	.873560	1.87	.948844	4.25	.051156	22
39	.822546	2.37	.873448	1.88	.949099	4.23	.050901	21
40	.822688	2.37	.873335	1.87	.949353	4.25	.050647	20
41	9.822830	2.37	9.873223	1.88	9.949608	4.23	10.050392	19
42	.822972	2.37	.873110	1.87	.949862	4.23	.050138	18
43	.823114	2.35	.872998	1.88	.950116	4.25	.049884	17
44	.823255	2.37	.872885	1.88	.950371	4.23	.049629	16
45	.823397	2.37	.872772	1.88	.950625	4.23	.049375	15
46	.823539	2.35	.872659	1.87	.950879	4.23	.049121	14
47	.823680	2.35	.872547	1.88	.951133	4.25	.048867	13
48	.823821	2.37	.872434	1.88	.951388	4.23	.048612	12
49	.823963	2.35	.872321	1.88	.951642	4.23	.048358	11
50	.824104	2.35	.872208	1.88	.951896	4.23	.048104	10
51	9.824245	2.35	9.872095	1.90	9.952150	4.25	10.047850	9
52	.824386	2.35	.871981	1.88	.952405	4.23	.047595	8
53	.824527	2.35	.871868	1.88	.952659	4.23	.047341	7
54	.824668	2.33	.871755	1.90	.952913	4.23	.047087	6
55	.824808	2.35	.871641	1.88	.953167	4.23	.046833	5
56	.824949	2.35	.871528	1.90	.953421	4.23	.046579	4
57	.825090	2.33	.871414	1.88	.953675	4.23	.046325	3
58	.825230	2.35	.871301	1.90	.953929	4.23	.046071	2
59	.825371	2.33	.871187	1.90	.954183	4.23	.045817	1
60	9.825511		9.871073		9.954437		10.045563	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.825511	2.33	9.871073	1.88	9.954437	4.23	10.045563	60
1	.825651	2.33	.870960	1.90	.954691	4.25	.045309	59
2	.825791	2.33	.870846	1.90	.954946	4.23	.045054	58
3	.825931	2.33	.870732	1.90	.955200	4.23	.044800	57
4	.826071	2.33	.870618	1.90	.955454	4.23	.044546	56
5	.826211	2.33	.870504	1.90	.955708	4.22	.044292	55
6	.826351	2.33	.870390	1.90	.955961	4.23	.044039	54
7	.826491	2.33	.870276	1.92	.956215	4.23	.043785	53
8	.826631	2.32	.870161	1.90	.956469	4.23	.043531	52
9	.826770	2.33	.870047	1.90	.956723	4.23	.043277	51
10	.826910	2.32	.869933	1.92	.956977	4.23	.043023	50
11	9.827049	2.33	9.869818	1.90	9.957231	4.23	10.042769	49
12	.827189	2.32	.869704	1.92	.957485	4.23	.042515	48
13	.827328	2.32	.869589	1.92	.957739	4.23	.042261	47
14	.827467	2.32	.869474	1.90	.957993	4.23	.042007	46
15	.827606	2.32	.869360	1.92	.958247	4.22	.041753	45
16	.827745	2.32	.869245	1.92	.958500	4.23	.041500	44
17	.827884	2.32	.869130	1.92	.958754	4.23	.041246	43
18	.828023	2.32	.869015	1.92	.959008	4.23	.040992	42
19	.828162	2.32	.868900	1.92	.959262	4.23	.040738	41
20	.828301	2.30	.868785	1.92	.959516	4.22	.040484	40
21	9.828439	2.32	9.868670	1.92	9.959769	4.23	10.040231	39
22	.828578	2.30	.868555	1.92	.960023	4.23	.039977	38
23	.828716	2.32	.868440	1.93	.960277	4.22	.039723	37
24	.828855	2.30	.868324	1.92	.960530	4.23	.039470	36
25	.828993	2.30	.868209	1.93	.960784	4.23	.039216	35
26	.829131	2.30	.868093	1.92	.961038	4.23	.038962	34
27	.829269	2.30	.867978	1.93	.961292	4.22	.038708	33
28	.829407	2.30	.867862	1.92	.961545	4.23	.038455	32
29	.829545	2.30	.867747	1.93	.961799	4.22	.038201	31
30	.829683	2.30	.867631	1.93	.962052	4.23	.037948	30
31	9.829821	2.30	9.867515	1.93	9.962306	4.23	10.037694	29
32	.829959	2.30	.867399	1.93	.962560	4.22	.037440	28
33	.830097	2.28	.867283	1.93	.962813	4.23	.037187	27
34	.830234	2.30	.867167	1.93	.963067	4.22	.036933	26
35	.830372	2.28	.867051	1.93	.963320	4.23	.036680	25
36	.830509	2.28	.866935	1.93	.963574	4.23	.036426	24
37	.830646	2.30	.866819	1.93	.963828	4.22	.036172	23
38	.830784	2.28	.866703	1.95	.964081	4.23	.035919	22
39	.830921	2.28	.866586	1.93	.964335	4.22	.035665	21
40	.831058	2.28	.866470	1.95	.964588	4.23	.035412	20
41	9.831195	2.28	9.866353	1.93	9.964842	4.22	10.035158	19
42	.831332	2.28	.866237	1.95	.965095	4.23	.034905	18
43	.831469	2.28	.866120	1.93	.965349	4.22	.034651	17
44	.831606	2.27	.866004	1.95	.965602	4.22	.034398	16
45	.831742	2.28	.865887	1.95	.965855	4.23	.034145	15
46	.831879	2.27	.865770	1.95	.966109	4.22	.033891	14
47	.832015	2.28	.865653	1.95	.966362	4.23	.033638	13
48	.832152	2.27	.865536	1.95	.966616	4.22	.033384	12
49	.832288	2.28	.865419	1.95	.966869	4.23	.033131	11
50	.832425	2.27	.865302	1.95	.967123	4.22	.032877	10
51	9.832561	2.27	9.865185	1.95	9.967376	4.22	10.032624	9
52	.832697	2.27	.865068	1.97	.967629	4.23	.032371	8
53	.832833	2.27	.864950	1.95	.967883	4.22	.032117	7
54	.832969	2.27	.864833	1.95	.968136	4.22	.031864	6
55	.833105	2.27	.864716	1.97	.968389	4.23	.031611	5
56	.833241	2.27	.864598	1.95	.968643	4.22	.031357	4
57	.833377	2.25	.864481	1.97	.968896	4.22	.031104	3
58	.833512	2.27	.864363	1.97	.969149	4.23	.030851	2
59	.833648	2.25	.864245	1.97	.969403	4.22	.030597	1
60	9.833783		9.864127		9.969656		10.030344	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.833783	2.27	9.864127	1.95	9.969656	4.22	10.030344	60
1	.833919	2.25	.864010	1.97	.969909	4.22	.030091	59
2	.834054	2.25	.863892	1.97	.970162	4.23	.029838	58
3	.834189	2.27	.863774	1.97	.970416	4.22	.029584	57
4	.834325	2.25	.863656	1.97	.970669	4.22	.029331	56
5	.834460	2.25	.863538	1.98	.970922	4.22	.029078	55
6	.834595	2.25	.863419	1.97	.971175	4.23	.028825	54
7	.834730	2.25	.863301	1.97	.971429	4.22	.028571	53
8	.834865	2.23	.863183	1.98	.971682	4.22	.028318	52
9	.834999	2.25	.863064	1.97	.971935	4.22	.028065	51
10	.835134	2.25	.862946	1.98	.972188	4.22	.027812	50
11	9.835269	2.23	9.862827	1.97	9.972441	4.23	10.027559	49
12	.835403	2.25	.862709	1.98	.972695	4.22	.027305	48
13	.835538	2.23	.862590	1.98	.972948	4.22	.027052	47
14	.835672	2.25	.862471	1.97	.973201	4.22	.026799	46
15	.835807	2.23	.862353	1.98	.973454	4.22	.026546	45
16	.835941	2.23	.862234	1.98	.973707	4.22	.026293	44
17	.836075	2.23	.862115	1.98	.973960	4.22	.026040	43
18	.836209	2.23	.861996	1.98	.974213	4.22	.025787	42
19	.836343	2.23	.861877	1.98	.974466	4.23	.025534	41
20	.836477	2.23	.861758	2.00	.974720	4.22	.025280	40
21	9.836611	2.23	9.861638	1.98	9.974973	4.22	10.025027	39
22	.836745	2.22	.861519	1.98	.975226	4.22	.024774	38
23	.836878	2.23	.861400	2.00	.975479	4.22	.024521	37
24	.837012	2.23	.861280	1.98	.975732	4.22	.024268	36
25	.837146	2.22	.861161	2.00	.975985	4.22	.024015	35
26	.837279	2.22	.861041	1.98	.976238	4.22	.023762	34
27	.837412	2.23	.860922	2.00	.976491	4.22	.023509	33
28	.837546	2.22	.860802	2.00	.976744	4.22	.023256	32
29	.837679	2.22	.860682	2.00	.976997	4.22	.023003	31
30	.837812	2.22	.860562	2.00	.977250	4.22	.022750	30
31	9.837945	2.22	9.860442	2.00	9.977503	4.22	10.022497	29
32	.838078	2.22	.860322	2.00	.977756	4.22	.022244	28
33	.838211	2.22	.860202	2.00	.978009	4.22	.021991	27
34	.838344	2.22	.860082	2.00	.978262	4.22	.021738	26
35	.838477	2.22	.859962	2.00	.978515	4.22	.021485	25
36	.838610	2.20	.859842	2.02	.978768	4.22	.021232	24
37	.838742	2.22	.859721	2.00	.979021	4.22	.020979	23
38	.838875	2.20	.859601	2.02	.979274	4.22	.020726	22
39	.839007	2.22	.859480	2.00	.979527	4.22	.020473	21
40	.839140	2.20	.859360	2.02	.979780	4.22	.020220	20
41	9.839272	2.20	9.859239	2.00	9.980033	4.22	10.019967	19
42	.839404	2.20	.859119	2.02	.980286	4.20	.019714	18
43	.839536	2.20	.858998	2.02	.980538	4.22	.019462	17
44	.839668	2.20	.858877	2.02	.980791	4.22	.019209	16
45	.839800	2.20	.858756	2.02	.981044	4.22	.018956	15
46	.839932	2.20	.858635	2.02	.981297	4.22	.018703	14
47	.840064	2.20	.858514	2.02	.981550	4.22	.018450	13
48	.840196	2.20	.858393	2.02	.981803	4.22	.018197	12
49	.840328	2.18	.858272	2.02	.982056	4.22	.017944	11
50	.840459	2.20	.858151	2.03	.982309	4.22	.017691	10
51	9.840591	2.18	9.858029	2.02	9.982562	4.20	10.017438	9
52	.840722	2.20	.857908	2.03	.982814	4.22	.017186	8
53	.840854	2.18	.857786	2.02	.983067	4.22	.016933	7
54	.840985	2.18	.857665	2.03	.983320	4.22	.016680	6
55	.841116	2.18	.857543	2.02	.983573	4.22	.016427	5
56	.841247	2.18	.857422	2.03	.983826	4.22	.016174	4
57	.841378	2.18	.857300	2.03	.984079	4.22	.015921	3
58	.841509	2.18	.857178	2.03	.984332	4.20	.015668	2
59	.841640	2.18	.857056	2.03	.984584	4.22	.015416	1
60	9.841771		9.856934		9.984837		10.015163	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′

′	Sine.	D. 1″.	Cosine.	D. 1″.	Tang.	D. 1″.	Cotang.	′
0	9.841771	2.18	9.856934	2.03	9.984837	4.22	10.015163	60
1	.841902	2.18	.856812	2.03	.985090	4.22	.014910	59
2	.842033	2.17	.856690	2.03	.985343	4.22	.014657	58
3	.842163	2.18	.856568	2.03	.985596	4.20	.014404	57
4	.842294	2.17	.856446	2.05	.985848	4.22	.014152	56
5	.842424	2.18	.856323	2.03	.986101	4.22	.013899	55
6	.842555	2.17	.856201	2.05	.986354	4.22	.013646	54
7	.842685	2.17	.856078	2.03	.986607	4.22	.013393	53
8	.842815	2.18	.855956	2.05	.986860	4.20	.013140	52
9	.842946	2.17	.855833	2.03	.987112	4.22	.012888	51
10	.843076	2.17	.855711	2.05	.987365	4.22	.012635	50
11	9.843206	2.17	9.855588	2.05	9.987618	4.22	10.012382	49
12	.843336	2.17	.855465	2.05	.987871	4.20	.012129	48
13	.843466	2.15	.855342	2.05	.988123	4.22	.011877	47
14	.843595	2.17	.855219	2.05	.988376	4.22	.011624	46
15	.843725	2.17	.855096	2.05	.988629	4.22	.011371	45
16	.843855	2.15	.854973	2.05	.988882	4.20	.011118	44
17	.843984	2.17	.854850	2.05	.989134	4.22	.010866	43
18	.844114	2.15	.854727	2.07	.989387	4.22	.010613	42
19	.844243	2.15	.854603	2.05	.989640	4.22	.010360	41
20	.844372	2.17	.854480	2.07	.989893	4.20	.010107	40
21	9.844502	2.15	9.854356	2.05	9.990145	4.22	10.009855	39
22	.844631	2.15	.854233	2.07	.990398	4.22	.009602	38
23	.844760	2.15	.854109	2.05	.990651	4.20	.009349	37
24	.844889	2.15	.853986	2.07	.990903	4.22	.009097	36
25	.845018	2.15	.853862	2.07	.991156	4.22	.008844	35
26	.845147	2.15	.853738	2.07	.991409	4.22	.008591	34
27	.845276	2.15	.853614	2.07	.991662	4.20	.008338	33
28	.845405	2.13	.853490	2.07	.991914	4.22	.008086	32
29	.845533	2.15	.853366	2.07	.992167	4.22	.007833	31
30	.845662	2.13	.853242	2.07	.992420	4.20	.007580	30
31	9.845790	2.15	9.853118	2.07	9.992672	4.22	10.007328	29
32	.845919	2.13	.852994	2.08	.992925	4.22	.007075	28
33	.846047	2.13	.852869	2.07	.993178	4.22	.006822	27
34	.846175	2.15	.852745	2.08	.993431	4.20	.006569	26
35	.846304	2.13	.852620	2.07	.993683	4.22	.006317	25
36	.846432	2.13	.852496	2.08	.993936	4.22	.006064	24
37	.846560	2.13	.852371	2.07	.994189	4.20	.005811	23
38	.846688	2.13	.852247	2.08	.994441	4.22	.005559	22
39	.846816	2.13	.852122	2.08	.994694	4.22	.005306	21
40	.846944	2.12	.851997	2.08	.994947	4.20	.005053	20
41	9.847071	2.13	9.851872	2.08	9.995199	4.22	10.004801	19
42	.847199	2.13	.851747	2.08	.995452	4.22	.004548	18
43	.847327	2.12	.851622	2.08	.995705	4.20	.004295	17
44	.847454	2.13	.851497	2.08	.995957	4.22	.004043	16
45	.847582	2.12	.851372	2.10	.996210	4.22	.003790	15
46	.847709	2.12	.851246	2.08	.996463	4.20	.003537	14
47	.847836	2.13	.851121	2.08	.996715	4.22	.003285	13
48	.847964	2.12	.850996	2.10	.996968	4.22	.003032	12
49	.848091	2.12	.850870	2.08	.997221	4.20	.002779	11
50	.848218	2.12	.850745	2.10	.997473	4.22	.002527	10
51	9.848345	2.12	9.850619	2.10	9.997726	4.22	10.002274	9
52	.848472	2.12	.850493	2.08	.997979	4.20	.002021	8
53	.848599	2.12	.850368	2.10	.998231	4.22	.001769	7
54	.848726	2.10	.850242	2.10	.998484	4.22	.001516	6
55	.848852	2.12	.850116	2.10	.998737	4.20	.001263	5
56	.848979	2.12	.849990	2.10	.998989	4.22	.001011	4
57	.849106	2.10	.849864	2.10	.999242	4.22	.000758	3
58	.849232	2.12	.849738	2.12	.999495	4.20	.000505	2
59	.849359	2.10	.849611	2.10	.999747	4.22	.000253	1
60	9.849485		9 849485		10.000000		10.000000	0
′	Cosine.	D. 1″.	Sine.	D. 1″.	Cotang.	D. 1″.	Tang.	′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(Names of animals are to be looked for under their *class* name.)